Engineering Library

The Engineer.

DEC 19 1927

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VOL. CXLIV.—No. 3751] LONDON: FRIDAY EVENING, DECEMBER 2, 1927 [PRICE ONE SHILLING BY IRELAND POST 1s. 3d.

PUBLIC NOTICES

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—
1. OVERHEAD TRAVELLING CRANES :—One of 25 Tons and Two of 12 Tons.
2. BRIDGE WORK :—Four Spans of 140 ft.

Tenders due on the 30th December, 1927, for No. 1, and on the 9th January, 1928, for No. 2.
Forms of Tender obtainable from the above at a fee of 5s. per set, which will not be returned. 7167

Assistant Engineers Required for the PUBLIC WORKS DEPARTMENT of the FEDERATED MALAY STATES for four years' service, after which, subject to satisfactory service, the officers appointed will be eligible for confirmation in the permanent and pensionable establishment. It is probable that the number of permanent appointments will be sufficient for those officers whose services have been entirely satisfactory, but no guarantee can be given. If at the end of four years' service an officer's services have been entirely satisfactory and he is not offered or declines further employment, he will be paid a bonus of 2850 dollars. Salary 400 dollars a month, rising to 800 dollars by annual increments of 25 dollars, plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but its purchasing power in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No income tax at present imposed by the Federated Malay States Government. Free passages provided. Candidates, age 23 to 26, preferably unmarried, must have received a good theoretical training, preferably at a University or College recognised by the Institution of Civil Engineers and possess a Civil Engineering Degree or obtained such other Diploma or Distinction in Engineering as the Secretary of State may decide in any particular case, or have completed articles with a civil engineer of good standing, and have passed the examination for Associate Membership of the Institution of Civil Engineers. In addition, candidates must have had at least one year's practical experience of civil engineering under a qualified civil engineer.—Apply at once by letter, giving brief details of qualifications and experience, and stating age and whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M/15224. 7152

Waterworks Engineer REQUIRED by the GOVERNMENT of NIGERIA for the PUBLIC WORKS DEPARTMENT for two tours of 12 to 18 months' service, with possible extension. Salary £800, rising by annual increments of £40 to £920 a year. Seniority allowance of £72 a year whilst on duty in Nigeria. Free quarters and passages and liberal leave on full salary. Candidates, not over 40 years of age, must possess a thorough knowledge of and experience in design and construction of Waterworks and in the investigation of Water Supplies in the Tropics or elsewhere. Corporate Members of the Institution of Civil Engineers preferred.—Apply at once by letter, stating qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M/207. 7151

PATENTS AND DESIGNS ACTS, 1907 AND 1919.
Notice is Hereby Given that THE NATIONAL CASH REGISTER COMPANY, of Dayton, in the State of Ohio, and Baltimore, in the State of Maryland, United States of America, SEEK LEAVE to AMEND the SPECIFICATION of the Application for LETTERS PATENT No. 263,196 for an invention entitled "Improvements in or relating to Cash Registers."
Particulars of the proposed Amendment were set forth in the Illustrated Official Journal (Patents) of the 23rd November, 1927.
Any person, or persons, may give Notice of Opposition to the Amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of the said Journal.
W. S. JARRATT,
7105 Comptroller-General.

University of London. A COURSE of FOUR LECTURES on "THE VENTILATION OF MINES" (considered from the engineering standpoint) will be given (with lantern illustrations) by Prof. HENRY BRIGGS, O.B.E., D.Sc., Ph.D., A.R.S.M., Hood Professor of Mining in the University of Edinburgh, at the IMPERIAL COLLEGE, ROYAL SCHOOL OF MINES (Prince Consort-road, South Kensington, S.W. 7), on DECEMBER 5th, 6th, 7th, and 8th, at 5.30 p.m. At the first Lecture the chair will be taken by Henry Walker, Esq., C.B.E., Chief Inspector of Mines.
ADMISSION FREE, WITHOUT TICKET.
EDWIN DELLER,
7029 Academic Registrar.

Crystal Palace School of Practical Engineering, Founded 1872,
MECHANICAL AND CIVIL ENGINEERING DIVISIONS.
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PRINCIPAL: MAURICE WILSON, M.I.C.E.
Assisted by Staff of Lecturers and Instructors. Thorough, up-to-date Practical and Theoretical Instruction. Course completed in 2 years. Students admitted at beginning of any term. 6642

Bethnal Green Board of Guardians. EXTENSION OF HOT WATER SUPPLY SYSTEM.
The Guardians invite TENDERS for the EXTENSION of the existing HOT WATER SUPPLY INSTALLATION at their Institution, Waterloo House, Waterloo-road, Bethnal Green, E. 2.
The plan and specification of the work may be inspected at the undermentioned address any weekday between the hours of 10 a.m. and 12 noon and 2 p.m. and 4 p.m. (Saturdays excepted), and a copy of the specification, with form of Tender, will be supplied upon payment of a deposit of £1, which will be returned on receipt of a bona fide Tender.
Sealed Tenders, in envelopes marked "Hot Water Supply Extension," must be delivered at my office not later than 12 Noon on Thursday, 29th December, 1927.
The Guardians do not bind themselves to accept the lowest or any Tender.
C. FAULKNER JONES,
Clerk to the Guardians.
Administrative Offices,
Bishop's-road, E. 2.
28th November, 1927. 7142

The Engineer

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PUBLIC NOTICES

Bethnal Green Board of Guardians. INSTALLATION OF ELECTRIC LIFT.
The Guardians invite TENDERS for the INSTALLATION of an ELECTRIC PASSENGER LIFT, including all Structural Work in connection therewith, at their Institution, Waterloo House, Waterloo-road, Bethnal Green, E. 2.
The specification of the work may be inspected at the undermentioned address any week-day between the hours of 10 a.m. and 12 noon and 2 p.m. and 4 p.m. (Saturdays excepted), and a copy of the specification, with form of Tender, will be supplied upon payment of a deposit of £1, which will be returned on receipt of a bona fide Tender.
Sealed Tender, in envelopes marked "Electric Lift," must be delivered at my office not later than 12 Noon on Thursday, 29th December, 1927.
The Guardians do not bind themselves to accept the lowest or any Tender.
C. FAULKNER JONES,
Clerk to the Guardians.
Administrative Offices,
Bishop's-road, E. 2.
28th November, 1927. 7143

The Madras and Southern Mahratta Railway Company, Limited, 25, Buckingham Palace-road, Westminster, S.W. 1, invite TENDERS for :—
(1) 182 TONS (Approx.) SPRING STEEL.
(2) 11,000 LINEAL YARDS SAIL CANVAS.
Tenders are due in as follows :—
By 2 p.m. on Tuesday, 20th December, 1927.
Tender forms obtainable at above address ; fee One Guinea, each, which is not returnable.
The Directors do not bind themselves to accept the lowest or any Tender. 7129

West Ham Union. TO LAUNDRY ENGINEERS.
The Guardians invite TENDERS for the SUPPLY and FIXING of ONE 225-SHIRT MACHINE for their Forest Gate Sick Home, Forest-lane, Forest Gate, E. 7.
Persons and firms desirous of tendering should forward specifications and full information as to the machine they propose to supply, and the tenders must be delivered to the undersigned not later than 10 a.m. on Thursday, the 15th December, 1927.
L. E. FRAQUET,
Clerk.
Board Room, Union-road,
Leytonstone, E. 11.
29th November, 1927. 7163

PUBLIC NOTICES

Bombay, Baroda and Central India Railway Company.
The Directors are prepared to receive up to Noon on Friday, 16th December, TENDERS for the SUPPLY of :—
1. STEEL MATERIAL (Plates, Bars, Angles, Flats, &c.).
2. GALVANISED CORRUGATED and PLAIN SHEETS.
3. PIG IRON.
Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of £1 each for No. 1 and 10s. each for Nos. 2 and 3, which will not be returned.
The Directors do not bind themselves to accept the lowest or any Tender.
S. G. S. YOUNG,
Secretary.
Offices : The White Mansion,
91, Petty France, Westminster, S.W. 1.
28th November, 1927. 7145

Gosforth Urban District Council. SEWAGE PUMPING MACHINERY.
The above Council invite TENDERS for the SUPPLY, ERECTION, and FIXING of FOUR SETS of ELECTRIC MOTORS and CENTRIFUGAL SEWAGE PUMPS, with Automatic Switchgears complete, at the Bridge Pumping Station, Gosforth.
Specification, schedule of prices, and form of Tender may be obtained on application to the Engineers, Messrs. Taylor and Wallin, Commercial Union Buildings, 47, Pilgrim-street, Newcastle-on-Tyne, on payment of £5 deposit, which sum will be returned on receipt of a bona fide Tender and the documents lent to the contractor for the purpose of preparing his Tender.
Sealed Tenders, endorsed "Sewage Pumping Machinery," on the prescribed form, with the schedule of prices properly filled in, must be delivered to me, the undersigned, at my office not later than 20th December, 1927.
The machinery is to raise UNSCREENED sewage containing rags, cloths, string, rope ends, &c., &c., brought down in the sewers ; ordinary centrifugal pumps for clean water are quite unsuitable, of no use for this work, and will not be considered.
The machinery will be let in one contract and will not be separated.
The Council do not bind themselves to accept the lowest or any Tender.
FRANK KIRBY,
Joint Clerk.
Urban District Council Offices,
Gosforth, Northumberland,
November, 1927. 7110

PUBLIC NOTICES

Borough of Hove. NEW GROYNE.
TENDERS are INVITED for CONSTRUCTING a TIMBER GROYNE opposite the WESTERN ESPLANADE.
A copy of the plan and other particulars may be obtained at the Borough Surveyor's Office on payment of Two Guineas, which will be returned on receipt of a bona fide Tender.
The lowest or any Tender not necessarily accepted.
Tenders, on forms supplied, addressed to the undersigned and endorsed "Tender for Groyne," will be received up to Five o'clock on Wednesday, the 14th December next.
W. JERMYN HARRISON,
Town Clerk.
Town Hall, Hove,
30th November, 1927. 7150

Metropolitan Water Board. DISPOSAL OF SPARE PLANT.
The Metropolitan Water Board invite TENDERS for the PURCHASE and REMOVAL of the following SPARE PLANT at their Battersea Works, Kirtling-street, Battersea Park-road, S.W. 11 :—
1 Vertical Boiler, 3ft. 6in. dia., 7ft. 10in. high.
1 Loco. Boiler, 3ft. 10in. dia., 18ft. 6in. long.
2 Steam Winding Engines, Churchill patent, to lift up to 2 tons.
1 Vertical "Deane" Sinking Pump.
1 Vertical "Cornish" Sinking Pump.
1 44-H.P. Crossley Oil Engine.
1 Grab, by Clarke, Chapman and Co.
1 Grab, Wild's patent.
4 Grabs, various, incomplete.
1 3½ Centrifugal Pump (Gwynne).
1 7in. Portable Centrifugal Pump (Gwynne).
1 7in. High-lift Centrifugal Pump (Gwynne).
1 10in. Centrifugal Pump (Gwynne).
1 12in. Two-stage Centrifugal Pump (Gwynne) on wooden framing, coupled to a High-speed Engine.
1 18in. Centrifugal Pump (Gwynne).
The plant may be inspected at the Battersea Works between the hours of 10 a.m. and 4 p.m. (12 noon Saturday) on application to the Foreman in charge.
Tenders must be submitted on the official forms, which contain a detailed list of the plant, and may be obtained from the Chief Engineer by personal application at the Offices of the Board (Room 156) or upon forwarding a stamped and addressed brief envelope.
Tenders, enclosed in sealed envelopes, addressed to the Clerk of the Board and endorsed "Tender for Purchase of Plant," must be delivered at the Offices of the Board (Room 122) not later than 11 a.m. on Thursday, 15th December, 1927.
The Board do not bind themselves to accept the highest or any Tender.
G. F. STRINGER,
Clerk of the Board.
Offices of the Board,
173, Rosebery-avenue, E.C. 1.
28th November, 1927. 7112

Corporation of Durban, Natal. TRAMWAY MANAGER.
The Corporation of Durban, South Africa, invites APPLICATIONS for the POSITION of TRAMWAY MANAGER.
Age must be under 44 years.
Salary commencing £1000 per annum, rising to £1250 by annual increments of £50.
The appointment is subject to the Corporation's Service and Leave Regulations.
Applications, with particulars of experience, should be sent to the undersigned.
By Order,
WEBSTER, STEEL & CO.,
36, Leadenhall-street,
London, E.C. 3.
7148 Agents to the Durban Corporation.

County Borough of Middlesbrough. EDUCATION COMMITTEE.
CONSTANTINE TECHNICAL COLLEGE.
APPOINTMENT OF PRINCIPAL.
APPLICATIONS are INVITED for the POSITION of PRINCIPAL of the CONSTANTINE TECHNICAL COLLEGE. The main Departments of the College will be those of Metallurgy, Engineering and Naval Architecture. Preference will be given to candidates with special qualifications in Metallurgical Science, together with administrative experience. Salary £900 per annum, with annual increments of £50 to a maximum of £1200. Particulars of the appointment and form of application may be obtained on receipt of a stamped addressed foolscap envelope, and applications should reach the undersigned not later than Saturday, 31st December, 1927.
W. J. WILLIAMS,
Director of Education.
Education Offices,
Middlesbrough.
29th November, 1927. 7159

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PUBLIC NOTICES

South Staffordshire Water-WORKS COMPANY.

CIVIL ENGINEERING DEPARTMENT.

APPLICATIONS are INVITED for the APPOINTMENT of SECOND CIVIL ENGINEERING ASSISTANT. Age 26-35 years.

Candidates must have had considerable experience in the design and maintenance of important waterworks, including impounding reservoirs, large pumping units, reinforced concrete service reservoirs, detection of waste and the distribution of water throughout large areas of supply.

Applicants must be corporate members of the Institution of Civil Engineers, having had responsible experience with a water company or Water Department of a Public Authority.

Ex-Service men will receive preferential consideration.

Commencing salary £450 per annum, which is subject to deductions under the Company's Superannuation Scheme.

Applications, stating age, details of education, training, qualifications and particulars of experience accompanied by copies (only) of three recent testimonials, endorsed "Civil Engineering Assistant," must be addressed and delivered to the undersigned not later than the 17th December, 1927.

FRED. J. DIXON, M. Inst. C.E.,
Engineer-in-Chief.

22nd November, 1927.
Engineer's Office,
26A, Paradise-street, Birmingham. 7078

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

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WANTED by Engineering Firm of Standing, a Very Smart MAN as REPRESENTATIVE. Must be good Engineer and well up in Mechanical Handling Problems, Conveyors, Elevators, &c.—Address, giving age, qualifications and salary expected, 7032, The Engineer Office. 7032 A

WANTED IMMEDIATELY by the EAST AFRICAN POWER and LIGHTING CO., Ltd., CHIEF ENGINEER, with view to ultimate appointment as General Manager. Must be under 45, of good education and with wide commercial and engineering experience. Good salary and prospects to first-class man.—Apply by letter only, stating age, experience, salary expected, and when free, to London Managers, BALFOUR, BEATTY and CO., Limited, 68, Queen-street, London, E.C. 4. 7123 A

CHIEF DESIGNER Wanted for Reinforced Concrete Work, capable of Taking Charge of Drawing-office; knowledge of Steelwork and Building Construction an advantage; must be keen, thoroughly experienced, and have held similar position previously.—Apply, by letter, to INDUSTRIAL CONSTRUCTIONS, Ltd., 44, Grosvenor-place, S.W. 1, stating experience, age and salary required and when free. 7162 A

ENGINEER REQUIRED by Well-known Eastern Merchants in South India. Applicants must have good practical knowledge of Engines and Machinery, be experienced as Draughtsman and Designers, and be capable of Preparing Estimates and attending to office correspondence. Age 25-30, single. First agreement 5 years; subsequent agreements 4 years, with six-month furlough on full pay between each agreement; first-class passage; outfit allowance.—Write, Box No. 346, c.o. Judd's, 47, Gresham-street, E.C. 2. 7149 A

ENGINEERING ASSISTANT REQUIRED for London. He should have experience in the Design and Construction of Sewers, Drainage Work and General Civil Engineering. Salary according to experience, but not exceeding £5 5s. a week.—Write, stating age, experience, &c., to Box 3, R. Anderson and Co., 14, King William-street, W.C. 2. 7161 A

GENERAL WORKS MANAGER.—WANTED, an up-to-date GENERAL WORKS MANAGER, age about 30 to 40, experienced in latest shop practice in Structural Work, Tank Construction, Oil and Gas Installations, and General Engineering and Foundry Practice. No application except from those with the above experience will be considered.—Apply, with two copies of recent testimonials or names of referees, and stating salary required, to the SECRETARY, Whessoe Foundry and Engineering Co., Ltd., Darlington. 7080 A

INDIA.—ASSISTANT WORKS MANAGER REQUIRED by a British Firm who have structural steel and general engineering works. Mechanical and electrical experience would be an advantage. Must be good organiser, used to control of men. Good salary and prospects; age under 35.—Address, sending full particulars, P3940, The Engineer Office. P3946 A

INDIA.—WANTED, ENGINEER, Capable Managing Shipbuilding, Repairing and Structural Works.—Write, stating age, qualifications and salary expected, to Box "Z.B. 663," c.o. Deacon's Advertising Agency, Fenchurch-avenue, London, E.C. 3. 7154 A

OIL-BURNING EQUIPMENT MANUFACTURERS REQUIRE ENGINEER SALESMAN, works trained, proved selling ability. Applicants without these qualifications need not apply. Salary basis.—Address, 7137, The Engineer Office. 7137 A

OLD-ESTABLISHED FIRM of MECHANICAL ENGINEERS in India REQUIRE a capable MACHINE TOOL SALESMAN. Good prospects. Age not over 30, unmarried. Good education and address and conversant with Railway and Ordnance Workshops requirements.—Reply, giving fullest details education, engineering experience, present work and salary, to Box "Z.A. 662," c/o Deacon's Advertising Agency, Fenchurch-avenue, London, E.C. 3. 7153 A

PLANT ENGINEER.—REQUIRED by Constructional and General Engineering Works on N.E. Coast, ENGINEER to Supervise Construction of New Shops, Installation of Plant, &c.

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State age, experience, and salary required.—Address, 7114, The Engineer Office. 7114 A

REINFORCED CONCRETE SPECIALISTS REQUIRE a good SENIOR DESIGNER. Previous experience essential. State full particulars of experience, with dates, age, and salary required.—Address, 7136, The Engineer Office. 7136 A

REQUIRED AT ONCE for India, MECHANICAL and ELECTRICAL ENGINEER, with organising ability and experience in the erection and installation of all classes of Steam, Electrical, and Mechanical Plant. Previous appointments in India preferable.—Address, stating age and experience, 7109, The Engineer Office. 7109 A

REQUIRED by a European Firm of Structural and General Engineers in India, an ASSISTANT FOREMAN in their Structural Department. Applicants must have experience in Template Making and be accustomed to Bridge, Roof and General Structural Work. Must be a bachelor and not more than 26 years of age.—Apply, stating age and full particulars of experience, to Z.Y. 660, care Deacon's Advertising Agency, Fenchurch-avenue, London, E.C. 3. 7155 A

SITUATIONS OPEN (continued)

STRUCTURAL ENGINEER REQUIRED by a British Firm in India, capable of organising and controlling office staff, including designing, estimating, drawing and correspondence. Good salary and prospects for really suitable engineer.—Address, giving full particulars, P3945, The Engineer Office, P3945 A

TRAVELLERS WANTED, Calling on Concerns where Rubber Hose Piping is used, pneumatic or otherwise, in the Eastern and Home Counties. Unique device of proved utility and vast possibilities, in repeated demand. Handsome commission. Representation on exclusive basis to right man.—NEWTON SALES CO., Ltd., 39, Victoria-street, S.W. 1. 7131 A

SITUATIONS OPEN (continued)

SALES ENGINEER REQUIRED, 25-35 Years, single, to sell Lubrication System. Salary £20 month plus 5 per cent. commission on sales.—Address, giving full personal details, 7160, The Engineer Office. 7160 A

WORKS MANAGER or First-class PRODUCTION ENGINEER for Railway Rolling Stock Works manufacturing Steel, Covered and Open Goods Wagons, Tanks, Underframes, R.C.H. Wagons, Brake Vans, &c. Consideration only given to applicants having Rolling Stock experience. Full details and salary.—Address, 7144, The Engineer Office. 7144 A

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Address.....

Date.....

SITUATIONS OPEN (continued)

WANTED AT ONCE, Capable MECHANICAL DRAUGHTSMAN, preferably one having experience in Concrete Mixing Machinery.—Apply, RANSOMES and RAPIER, Ltd., Waterside Works, Ipswich, stating age, qualifications, and salary required. 7135 A

WANTED, DRAUGHTSMAN, Experienced in General Structural and Mechanical Engineering (able to do own calculations).—Address, P3943 The Engineer Office, stating classes of work, experience, age, and salary required. P3943 A

WANTED, First-class DRAUGHTSMAN, with Good experience in the design of Hydraulic Presses, Pumps and Accumulators. A knowledge of Oil Presses is desirable, but not essential.

Applications treated confidentially.

Address, "CONFIDENTIAL," Tangyes Limited, Cornwall Works, Birmingham. 7156 A

WANTED in Midlands, TWO JUNIOR DRAUGHTSMEN, thoroughly experienced in Overhead Electric Cranes; also ONE experienced in Conveyor and Elevator Work. State age, experience, and wages required.—Address, 7111, The Engineer Office. 7111 A

WANTED, DRAUGHTSMAN, with First-class knowledge of Chemical and By-product Recovery Installations, also Gasworks Plant. State age and salary required.—Address, 7117, The Engineer Office. 7117 A

COMPETENT DRAUGHTSMAN REQUIRED, Experienced in Conveying and Elevating Machinery and Light Steel Structural Work.—Address, stating age, wage, and experience, 7127, The Engineer Office 7127 A

CRANE DRAUGHTSMEN, with First-class Experience, REQUIRED, Manchester district. State age, experience, and salary required.—Address, 7166, The Engineer Office. 7166 A

DRAUGHTSMAN, First Class, WANTED IMMEDIATELY, for Coal, Coke and Cement Handling Plants, Structural Work, &c.—Address, 7158, The Engineer Office. 7158 A

DRAUGHTSMAN REQUIRED for Structural Steel Works in London district; must have had previous experience in the preparation of workshop details.—Address, stating age, salary expected, and giving outline of qualifications, 7139, The Engineer Office. 7139 A

DRAUGHTSMAN WANTED, with Experience in Camming and Tooling Automatic Screw Machines. Please state age, experience, and salary required.—Address, 7124, The Engineer Office. 7124 A

ENGINEERING DRAUGHTSMAN REQUIRED, experienced in Powdered Fuel Work.—Address, stating experience and salary, 7157, The Engineer Office. 7157 A

ENGINEERING DRAUGHTSMAN WANTED in Works Maintenance Department of a large factory. Experience in the lay-out of Electrical, Steam, and Dust Collecting Plants would be a recommendation. In applying state age, references, and wage expected.—Address, "ELECTRICAL," Wm. Porteous and Co., Glasgow. P3950 A

MECHANICAL and GENERAL DRAUGHTSMAN REQUIRED, to prepare detail and scheme drawings for proposed new Plant and Buildings.

Candidates should be about 30 years of age, and the following training is essential:—

Sound technical training, diploma of one of the principal Engineering Colleges, 3 years' workshop experience with well-known firm of general engineers, 3 years' drawing-office experience, and some experience of estimating costs.

Applications will be considered only from first-class men with the above training and experience.

Address in the first instance for application forms, 7133, The Engineer Office. 7133 A

SENIOR DRAUGHTSMAN REQUIRED, with Pneumatic experience, preferably on Air Brakes. Please state salary.—Apply, G. D. PETERS, Windsor Works, Slough. 7128 A

WANTED, FOUNDRY FOREMAN, Thoroughly experienced in High-class Light Engine Castings; must have special knowledge of Iron and Gun-metal mixtures for heavy pressures, and all Admiralty test requirements. About 60 hands employed. None but thoroughly reliable experienced men with good references need apply. Good position for suitable man.—State age, wages, and full particulars to A. G. MUMFORD, Ltd., Culver-street Engineering Works, Colchester. 7130 A

FIRST-CLASS FOREMAN MOULDER WANTED for large Steel Foundry doing medium and heavy work. Must be up-to-date with the latest Foundry practice and the control of men. Applications will be treated strictly confidential, stating age, experience, and salary required.—Address, 7165, The Engineer Office. 7165 A

MANUFACTURER of CASH ADDING MACHINERY REQUIRES energetic YOUNG MAN to Train as SHOP FOREMAN in London Repair Department. Must have first-class technical training and workshop experience.—Address, 7113, The Engineer Office. 7113 A

ESTIMATING CLERK (ASSISTANT) REQUIRED for Railway Wagon Works in Midlands. State age, experience, salary required, and when at liberty.—Address, 7134, The Engineer Office. 7134 A

LABOUR CLERK REQUIRED for Works, London, N.W. Man of some years, able to handle tactfully and intelligently the engagement of male and female labour.—Address, P3948, The Engineer Office. P3948 A

SITUATIONS WANTED

ENGINEER (24), 5 Years Public School, 2 Years Manchester University, 6 months chemical works, 12 months research, 2 years in charge shop precision engineering works, DESIRES MORE RESPONSIBLE POSITION.—Address, P3928, The Engineer Office, P3928 B

ENGINEER, 1st B.O.T., M.I.M.E., 7 Years' Overseeing, sea and D.O. experience, would like ENGAGEMENT as Surveyor, Inspector, or Instructor, near Liverpool preferred. Salary accommodate.—Address, P3957, The Engineer Office. P3957 B

ENGINEER, 1st Class Draughtsman and Translator (English, young); fluent technical French, 5 years' experience Continent, mechanical and structural engineering.—"B.," 3, Westgate-road, Beckenham. 7138 B

EXPERT SALES ORGANISER and MANAGER (Engineering and Allied Trades) REQUIRES POST with live firm. Free very shortly. British and foreign experience. Salary by results. Latest methods. Can get business.—Address, P3947, The Engineer Office. P3947 B

HEATING ENGINEER (27), Qualified, SEEKS more progressive POST. Considerable experience design and supervision of erection heating and domestic apparatus and very latest heating methods; also mechanical engineering and water treatment. Recently supervised several large engineering contracts in London and provinces. Experienced buyer and general commercial knowledge.—Address, P3949, The Engineer Office. P3949 B

JAMAICA.—ENGINEER, M.I. Mech. E., Leaving for Jamaica on January 2nd, will UNDERTAKE INSPECTIONS, COMMISSIONS, or REPRESENTATION. Experience: Refrigeration, harbour, dredging, light-draught transport and general.—Address, G. LUMLEY, "Glenholme," Jesmond, Newcastle-on-Tyne. P3958 B

For continuation of Small Advertisements see page 3.

A Seven-Day Journal

Synthetic Nitrogen.

IN a "Journal" note in our issue of November 11th we quoted the report of the British Sulphate of Ammonia Federation, summarising the present and prospective position of the world's output and consumption of fixed nitrogen. According to the Federation, if the synthetic nitrogen works now being constructed or planned are completed in accordance with announced intentions, the total annual output of fixed nitrogen from all sources will by 1930–31 amount to about 2,200,000 tons, or 900,000 tons in excess of the present annual consumption. There is no evidence so far as the Federation can see that that excess will be absorbed by the increase in the consumption during the next four years, and accordingly it is suggested that the fall in price which has marked the fixed nitrogen market during the past four years will continue. A commentary on the Federation's argument is supplied by the news received since our last issue to the effect that Imperial Chemical Industries has decided to proceed at once with the erection at its Billingham synthetic nitrogen works of two additional units, each capable of an annual production of 50,000 tons of fixed nitrogen. Each of the new units will have a capacity for the output of 165 tons of ammonia per day, and in conjunction with them there will be subsidiary plant for converting this ammonia into sulphate, nitrate, bicarbonate, nitro-chalk, and other nitrogen products. The extensions will, it is hoped, be completed in 1930. They will raise the output of the Billingham works to the equivalent of 750,000 tons of sulphate of ammonia per year. At present 5000 men are employed at Billingham, but when the extensions are completed this number will be fully trebled.

Cable and Wireless Telegraphy.

IT has been very persistently maintained for some time that wireless telegraphy is not, and is not likely to become, a thorn in the flesh of the cable telegraphy companies. The arguments employed to support that view are not very convincing. They are based chiefly on the certainty of cable transmission and the secrecy which it is held to ensure. Trustworthiness and freedom from transmission errors are, however, factors which should be well within the reach of wireless telegraphy developments. As regards secrecy, there are many messages in connection with which it is not a very important asset, while for those in which it is important the development of the beam system of wireless telegraphy would seem to promise some measure of freedom from eavesdropping. From the remarks made at the general meeting last week of the Western Telegraph Company, Ltd., it is evident that the cable companies are no longer so unconcerned about the competition of wireless telegraphy as at one time we thought them to be. The Western Company has already felt the effect of the wireless competition brought into being by the establishment in May, 1926, of the Transradio Company of Argentina and the Brazilian Radio Company. These companies offered international services at rates lower than those charged by the cable companies, and succeeded in diverting a certain amount of traffic from the cables. The All-America Cables Company, rather hurriedly, in the opinion of some, replied by reducing its charges and the Western Company was forced to follow suit. Since August 1st of this year the cable charges have been on the same level as those of the wireless services. The result, we learn, has been an improvement in the number of words carried by the cables, and the improvement is said to be keeping up. Speaking at the Western Company's meeting, the chairman, Sir John Denison-Plender, stated that in his opinion the situation might undergo further changes and that in the interests of all concerned—Governments, the public, and the communication companies—co-operation rather than competition should be established between wireless and cable telegraphy.

Armstrong's and Vickers'.

ON Monday last the scheme for the amalgamation of certain branches of the two undertakings was approved, not altogether unanimously in some instances, by the various categories of share and stock holders in Sir W. G. Armstrong, Whitworth and Co., Ltd., and Vickers Ltd. The underlying object of the scheme is to concentrate under one management—that of the new £21,000,000 company, Vickers-Armstrong, Ltd.—the whole of the armament and naval shipbuilding activities at present being carried on by the two companies separately. For the fixed assets transferred to the new company Armstrong's are to receive £4,500,000 in shares and for their floating assets £600,000 in cash, £1,000,000 in shares, and a further sum in shares which has still to be settled. For the fixed assets transferred to the new company Vickers are to receive £8,500,000 in shares. These assets were entered in the company's last balance sheet at just under £3,000,000, and after they have been transferred will leave Vickers with fixed assets having a balance sheet valuation of about £16,500,000. The floating assets transferred by Vickers are to be valued on December 31st. From the particulars given above and in our last issue it should be clear that Vickers Ltd. will survive the amalgamation with a very considerable amount remaining of its present identity and activities. The position in this respect as regards Armstrong, Whitworth's has, it seems, been somewhat misunderstood. It, too, will remain with a large measure of separate interests. It will continue to operate the Walker shipyard, subject to the restriction that it will not build any warships or fleet auxiliaries or other ships intended to carry more than twelve passengers and exceeding 550ft. in length. It will retain the Scotswood works and the Close Foundry, its locomotive business, and also its machine tool business, which will be transferred from Openshaw to Scotswood. The position may be summarised by saying that the two old companies will continue as at present, except that they will be restrained from making armaments, building warships, and fleet auxiliaries, and from manufacturing certain commercial products including alloy steels, rough forgings exceeding 30 cwt. in weight, rough steel castings, and steel drop stampings.

Large Submarines.

THE launch of the American submarine V 4, which took place recently at the Portsmouth (N.H.) Navy Yard, marks a new stage in the development of these craft. The V 4 exceeds in tonnage and other measurements the British vessel X 1, hitherto the largest submarine afloat. Whereas the X 1 has a surface displacement of 2525 tons and is 350ft. long, with a maximum breadth of 29½ft., the corresponding dimensions of the V 4 are 2878 tons, 381ft., and 33½ft. In speed and armament, however, the X 1 is greatly superior. She is understood to have motors of 6000 brake horse-power, which give her a speed of 22 knots on the surface, and her armament comprises four 5·2in. guns, twin-mounted in closed turrets, and six torpedo tubes. The V 4 has Diesel engines of 2800 brake horse-power for a contract speed of 15 knots. She is designed primarily as a minelayer and has stowage space for sixty mines, together with dropping gear. A single 6in. gun is mounted on deck without protection, and there are four torpedo tubes. The estimated cost, complete with armament, is £1,230,000, as compared with £941,794 for the X 1, though subsequent modifications have brought the latter figure to about £1,000,000. Two new American vessels, V 5 and V 6, now under construction are believed to exceed 3000 tons, this being also the displacement of the French "croiseur-sousmarin" now on the stocks at Cherbourg. British naval opinion favours smaller boats, such as those of the "O" class, averaging 1400 tons, which are considered to answer all reasonable requirements as to radius, habitability, and fighting power, besides being safer and easier to manœuvre than the so-called submarine cruisers. These vessels cannot operate effectively unless there is ample sea room and deep water, and they take a considerable time to dive.

Swan, Hunter and Wigham Richardson, Ltd

AT the staff dinner of Swan, Hunter and Wigham Richardson, Ltd., of Wallsend, which was held at Newcastle-upon-Tyne on Saturday last, November 26th, some interesting references were made to the work of the firm. Both Sir George B. Hunter and Mr. C. S. Swan were present and spoke. Mr. N. M. Hunter, the general manager of the Wallsend Shipyard, said that during the year that yard had produced about 60,000 tons of shipping, nearly 20,000 tons in excess of last year's output of the Tyne yards of the firm. If to this output the various sections of the large floating dry dock which the firm was constructing for the Singapore base were to be added, then the total amount of work for the year was about 113,000 tons for the Wallsend yard alone. Such an output indicated the sincere work which had been put in by the indoor and outdoor staff alike and by every workman. The performance was, he considered, a very good one, as 113,000 tons represented about 26,000 tons in excess of the record 1906 year of the firm, in which the Mauretania was launched. During the evening several references were made to the present difficult position in the coal industry. It was pointed out that there were in the British mercantile marine to-day over 500 vessels in which oil was burned under the boilers or used directly in internal combustion engines. Such a figure does not include vessels of the Royal Navy, in which oil is very largely used. A sum of about £9,500,000 was quoted as representing the money which shipowners annually pay to other countries for oil supplies, which money, assuming that coal could equally well be used, might with advantage be spent in Great Britain.

Electricity Supply in Rural Areas

FOR some time past the Electricity Commissioners have been giving attention to the question of promoting and extending the supply of electricity in rural areas. Special attention has been paid to the difficulties encountered by supply authorities arising mainly in connection with overhead lines and wayleaves. In August last the Commissioners issued a Memorandum on Electrical Development in Rural Areas, dealing more particularly with the importance of overhead line distribution and wayleave facilities as factors in the economic extension of rural supplies, and inviting the active support of local authorities, landowners and others who are in a position to facilitate the erection of overhead lines. Recently further steps have been taken to secure a comprehensive review of the whole position, to co-ordinate the results of inquiries and investigations, and to obtain such further information as is necessary to complete a survey of the position. With this end in view the Commissioners convened a representative conference on November 22nd of the various departments, associations, &c., interested in different aspects of rural electrification. The Commissioners informed the conference that they had initiated a detailed review of the present regulations and procedure affecting overhead lines and wayleaves, more particularly in relation to the problem of distribution in rural areas, and had convened a conference with the electrical engineers of various authorities for the purpose of considering technical and other modifications in the regulations and procedure. After discussing the subject generally the conference appointed two sub-committees to investigate and report on the different branches of the subject and remitted other aspects of the matter to the British Electrical Development Association for consideration in consultation with other representative bodies. Another meeting of the conference is to be held early in March to consider the reports of the sub-committees and the British Electrical Development Association, when it is expected that a revised draft of the regulations of the Commissioners and other information on the general question will be available.

A Suggested Clyde Shipbuilding Combine.

AT the launch of the Canadian Pacific liner Duchess of Atholl—particulars of which ship were given in a "Journal" note last week—the Duke of Montrose, speaking at the luncheon which followed, made the suggestion that there should be a combine between shipbuilding firms on the Clyde, with a view to pooling knowledge and resources, purchasing in bulk, and eliminating what he termed "cut-throat competition in order to secure a limited share of the work which was going." Such competition, he thought, in the face of assertive competition from firms south of the Border and abroad, was likely to jeopardise the future of shipbuilding on the Clyde. The suggestion put forward has since been somewhat elaborated by the speaker. The Duke, it is reported, regards it as eminently desirable that any such amalgamation of interests should be controlled by Scottish people and based on Scottish capital rather than that Clyde firms should become mere appendages to English corporations. He would also like to see, it is said, a union between shipbuilding, engineering, steel making, and colliery undertakings, so that one authority would control the production of the finished article right up through the various stages from the raw materials. While some financial rearrangement might be necessary, it is unnecessary, he holds, that the participating companies should lose their identity. Several shipbuilders have expressed opinions on the plan, but while the advantages are generally recognised, there seems to be some fear that the plan would present difficulties in practice. Sir George Hunter suggests that the Shipbuilding Employers' Federation should stand for more than dealing with labour and wages questions, and has given expression to the hope that something at least may be done to save the shipbuilding industry from undue competition.

Super-Liners for Atlantic Service.

IN the course of the past week rumour was again busy with regard to the construction of 60,000-ton liners for the Atlantic service of the Cunard Line and the White Star Line. It is well known that both companies are keenly alive to the future requirements of the Atlantic passenger service and the efforts of American and continental owners to outbid our present largest and fastest ships will not pass uncountered. At the time of writing, however, there is no confirmation from either company of the report that an order for a 60,000-ton ship has been or will shortly be placed. With regard to the Cunarder, a rival note of expectancy has been expressed in both Clyde and Tyne shipbuilding circles, but the new White Star liner is, of course, associated with Harland and Wolff, Ltd., of Belfast; moreover, it has been stated that it will be propelled by oil engines. That such engines to develop the required power can now be built is not to be denied. In a recent paper read in Copenhagen, Mr. Paul Hansen gave full details of an arrangement which has been worked out for the re-engining of the United States 60,000-ton liner Leviathan. The proposal provides for four sets of twelve-cylinder, double-acting, four-cycle oil engines of the Burmeister and Wain type, each of which would have twelve cylinders with a bore of about 41in. and a stroke of about 77in., and would develop 25,000 S.H.P. at 100 r.p.m. The total output would be 120,000 S.H.P. maximum or 100,000 in service. Between the two main engine-rooms there would be provided a compressor room with four eight-cylinder air compressors. The actual length of the machinery space would be slightly less than in the existing steam turbine installation.

The Shannon Power Scheme.

No. I.

ALTHOUGH rather less than three years have elapsed since it was announced that an offer had been put forward by Siemens-Schuckert to submit a scheme to the Irish Government for the development of hydro-electric power from the river Shannon, the civil engineering work associated with the scheme is now well advanced. Good progress has been made with the construction of the head and tail-race, the weir and intake, and the sluice house for the power station. While the construction of the power-house building is only just beginning, parts of the water turbines have been delivered to the site, and transmission lines are becoming conspicuous in many parts of Ireland. From what we saw during a recent visit to the building sites, there is little doubt that the contractors will complete their task within the allotted time.

In spite of opinions that have been expressed on the placing of the contract with a German firm, an impartial consideration of the parliamentary White Paper, dated February 26th, 1924, and of the published reports of Siemens-Schuckert, and the independent experts who were engaged to examine the scheme, shows clearly that the reason is to be found in the initiative and enterprise of Siemens-Schuckert in putting forward their proposals, and in the care and energy displayed in convincing the experts and the Government that the technical and economic bases of the proposals were sound. If any English firm had tackled the matter in the same way, there seems to be no doubt that it would have been given equal opportunities, and the money that is being spent

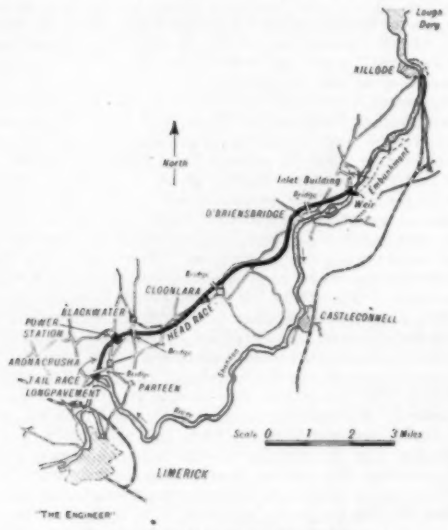


FIG. 1—GENERAL PLAN OF SCHEME

on the undertaking might have come to this country. An offer was made by Siemens-Schuckert to carry out the necessary investigations and to prepare a scheme for the consideration of independent experts, who were to decide whether the proposals were sound. Had the experts reported unfavourably on the proposals, the firm would not have received any remuneration for its investigations, and, needless to say, it would not have secured the contract. The experts who were consulted, and who spent a considerable amount of time in Ireland after the Siemens report had been prepared, were Waldemar Borgquist, of Stockholm; Eugen Mayer-Peter, of Zürich; Thomas Norberg Schulz, of Christiania; and Arthur E. Rohn, of Zürich. After a very thorough examination of the conditions, and when all the engineering problems which the undertaking involves had been gone into, the experts decided that with certain modifications the proposals were satisfactory. The Irish Government thereupon took the necessary steps to introduce legislation to enable it to proceed with the scheme, and in due course the work was begun by Siemens-Schuckert, under binding contracts.

The present water level of Lough Derg, see the accompanying map, Fig. 1, is about 110ft. O.D. in the winter, and 107·5ft. O.D. in the summer, and it is proposed to utilise about 100ft. of the fall from that point to the sea for the purpose of generating electric power, and to distribute this power throughout the Free State. The fall of 100ft. will be obtained by drawing the water from the Shannon above O'Brien's Bridge, and conducting it through a head race canal, approximately 7½ miles long, across the country to Ardnacrusha, where the power-house is about to be erected. From the power-house the tail-race will run to meet the Shannon again at Parteen Lax. Above O'Brien's Bridge—see map, Fig. 1—a weir is being constructed in the river to raise the level of the water approximately to the level of Lough Derg, and, where economically justifiable, embankments are being built along the river to prevent flooding of the adjacent lands.

As modified by the experts, the scheme is to be developed in three stages:—(1) Partial development with a plant capacity of 90,000 horse-power; (2) further development with a plant capacity of 180,000 horse-power; and (3) the same plant capacity with additional water storage. With the plant capacity of 90,000 horse-power provided under the partial development scheme, it will be possible to supply 153 million units in the driest year, and 288 million units in a normal year. In calculating the revenue, 153 million units were taken, and the storage available in Lough Derg will enable that output to be apportioned throughout the year to suit the load curve prepared by the experts.

The total expenditure is estimated at £5,200,000, of which about £2,500,000 will be spent on civil constructional works, £184,000 on mechanical plant, and £1,770,000 on electrical plant, &c., including all transmission lines. The remaining capital is needed to pay interest on the money whilst the work is being carried out, and to meet deficiencies during the first two years. With this expenditure and with the annual charges shown in the experts' report, the total annual outgoings on the scheme are estimated at about £486,000, which will cover all interest charges, maintenance and renewals, salaries, wages, &c. Two alternative methods of

FIG. 2—MAP OF IRELAND SHOWING TRANSMISSION LINES AND SUB-STATIONS

estimating the cost of the supply of electric power have been suggested by the experts:—(1) Assuming an average cost throughout the country to be calculated by dividing the total cost of the supply by the total number of units delivered, this would work out at 0·84d. at the low-tension side of the transformers; and (2) assuming a graded cost depending on the point of delivery, this would work out at 0·52d. per unit at the end of the 110 kV lines, 1·21d. at the end of the 38 kV lines, and 2·06d. at the end of the 10 kV lines.

Taken in conjunction with the estimated demand, these prices would yield approximately £486,000 per annum, so that, given this demand, the scheme would be self-supporting, would yield interest at 5·5 per cent., provide for amortisation in forty years, and pay all annual charges necessary for the operation and maintenance of the works. In 1924 the annual consumption of electricity per head of population in the Irish Free State was only 16 units, which, of course, is very low, but it is estimated that, even if the Shannon power scheme had not been decided upon, that the consumption would not be much less than 36 units by the year 1931. With the additional facilities for cheap power under the Shannon scheme, the rate of increase, it is considered, should be much greater than that, and by the year 1931 it will be necessary to proceed with the further development scheme involving the provision of additional power-house plant, bringing the total capacity up to 180,000 horse-power. Compared with the rate of increase of consumption in other countries within recent years, the experts' estimates cannot be regarded as unduly optimistic, although it is to be remembered that Ireland is not by any means highly industrialised. At the time the experts prepared their report, the total capacity of the electricity works in the Irish Free State was 33,000 kilowatts, including the plant required for the Dublin tramways, and it is improbable that the capacity has increased very much since. It is expected, however, that shortly after the establishment of the large electrification scheme, an output of 45,000 to 50,000 kilowatts of generating plant will be required, corresponding to the 150 million kilowatt-hours of electrical energy. Accordingly, the experts fixed the initial capacity of the station at 90,000 horse-power, to be developed by three 30,000 horse-power turbines.

HYDRAULIC WORKS.

The winter level of Lough Derg will not be raised during the time the partial development scheme is in operation, but in order to provide the necessary storage, it will be maintained longer than at present. This will affect the river as far as Meelick, and embankments are being built along the river to prevent flooding, wherever the cost of the embankments is less than the value of the land protected. Outside the embankments drainage trenches will be provided to receive the run off of the adjoining lands. The level of the water in these trenches will be controlled by automatic pumps discharging over the embankments and into the river. The existing weirs at Meelick (Galway) and Keelogue will be improved to facilitate the discharge of the water from the Banagher district. It is hoped that this improvement of the weirs will ameliorate the conditions for some distance north of Meelick, but at present the extent of the benefit cannot be estimated with any degree of accuracy. In the area between Lough Derg and Meelick, about 2000 acres of land are at present liable to annual floods, and in the future they will be protected by low-lying embankments, holding up about 15in. to 18in. of water, except in areas where the cost of the protection is greater than the value of the land to be protected. A rough estimate of the lands improved north of Portumna might be given as 2000 to 3000 acres, but no account has been taken of this improvement in the estimated revenue to be derived from the works.

North of the existing weir at Killaloe the Shannon will be dredged, and on completion of the works the existing weir will be removed. On the east side the river will be embanked from the site of Fort Henry Hill to the end weir at Parteen Villa and the Kilmastulla River, and various land drains will be collected in a drain at the back of these embankments and discharged into the river below the weir. On the west side a short embankment, about ¾ mile long, will be constructed, and certain lands lying below 110 O.D. will be acquired and permanently flooded. The drainage water on the west side and the Black River will also be collected in a back drain and syphoned underneath the intake works and discharged into the river below the weir. The

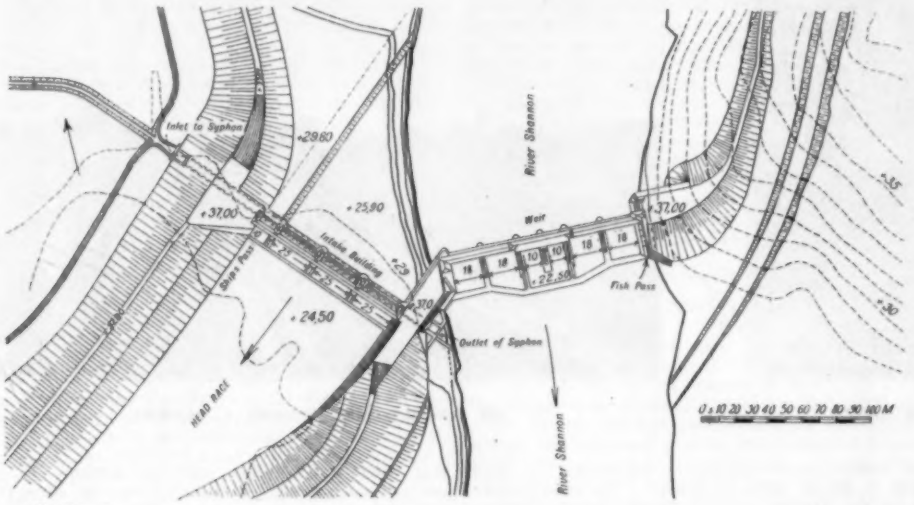


FIG. 3—WEIR AND INTAKE WORKS

embankments along the Shannon north of Parteen Villa are intended to secure the total available head of water, and to have practically the lake level at the entrance to the head-race. The concrete weir—see Fig. 3—is founded on rock and will hold up 24ft. of water. There are to be four openings, each 18 m. (59ft.) wide, with sluice gates, and two lower openings, each 10 m. (32·8ft.) wide, with double gates, the openings being designed to discharge the river in full flood. Under the advice of expert fishing authorities, it is proposed to provide a fish pass in the weir. The concrete canal head will be fitted with stop gates, so that the water can be cut off if necessary. The head-race canal crosses the country from O'Brien's

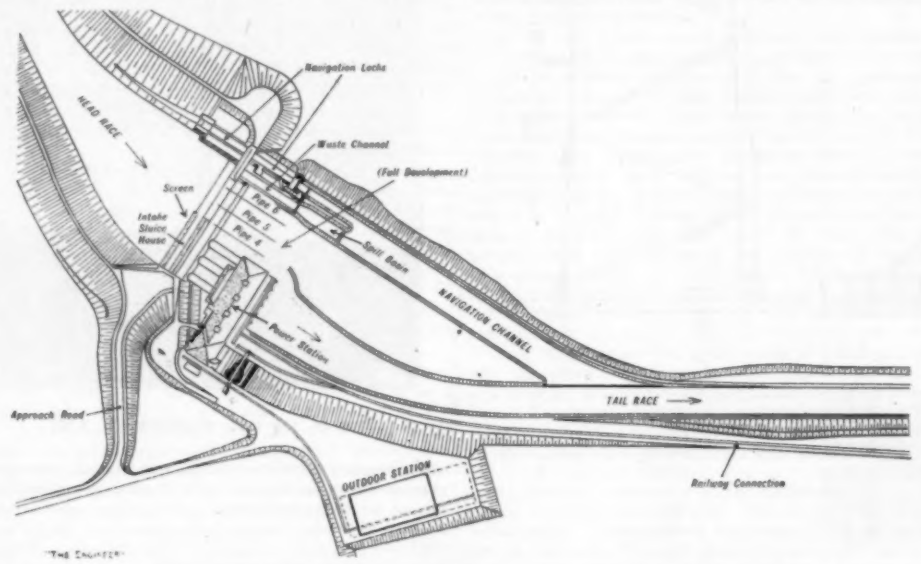


FIG. 4—GENERAL LAY-OUT OF POWER STATION AND ADJOINING WORKS

Bridge—shown in the map, Fig. 1—just north of Cloonlara, and extends to the power-house.

THE POWER STATION.

A glance at the plan—Fig. 4—will give the reader a clear idea of the general lay-out of the power station, and it will be observed that on approaching it the head-race gradually widens out into a head-bay where the water velocity is reduced, this being necessary on account of the fact that it is proposed to use the head and tail-race for navigation. The bed of the tail-race is designed so as to reduce the velocity and swirl of the spent water, but after a distance of about 100 m. (328ft.) the tail-race has practically a level bed. The navigation locks on the south side are divided from the water canal by a rock wall, and consist of two deep locks for enabling boat traffic to surmount the 32 m. (105ft.) between the head and tail-race, and thus render both canals navigable from Limerick to Killaloe.

The tail-race will be about a mile and a half long and 22 m. wide (72ft.) at the bottom, and will run down the valley and discharge into the Shannon below St. Thomas' Island at Parteen Lax. In order to get an adequate discharge in times of flood and to avoid backing up and consequent loss of head, it was at first considered advisable to deepen the tidal portion of the Shannon from St. Thomas' Island to Sarsfield Bridge wherever the reefs of rock approach the surface, but a detailed examination of the project has shown that the work would be uneconomical on account of the high cost of removal of rock in the river bed and of the small advantage to be gained in the power output. A branch line from the Great Southern Railway at Longpavement is being run to the power-house at Ardnacrusha for the transportation of plant, &c.

THE ELECTRICAL SCHEME.

In subsequent articles we shall deal more fully with the civil engineering work, and we will now consider in a brief manner the general electrical scheme. The electrical energy is to be distributed over the whole of the country by means of a high-tension network feeding all towns and villages. The primary transmission line, at a pressure of 110 kV, will extend across the country and join the two chief centres, namely, Dublin and Cork. To facilitate distribution when the scheme is fully developed a sub-station will be erected at Maryborough, and will be fed from the main 110-kV transmission line. The high-tension distribution network now in the course of construction is shown in the map, Fig. 2, where the thick lines between Dublin and Cork represent the main 110-kV transmission system. The line between Dublin and Limerick will consist of two three-phase circuits carried on steel towers, whilst the line between Limerick and Cork will consist of a single three-phase circuit. The thin lines on the map represent the 38-kV transmission system, which will extend over a very wide area, and will be fed from transforming stations at Limerick, Cork and Dublin, and eventually from a sub-station at Maryborough. Owing to the ring formed by the 38-kV lines a supply can be provided in two directions. Current will be generated at the power station at a pressure of 10,500 volts, and will be transformed up to 38 kV and 110 kV at the station. The 110-kV sub-station at this point will be of the outdoor type, whilst the 38-kV sub-station will be of the indoor type. The remaining three sub-stations at Cork, Maryborough and Dublin will also be outdoor sub-stations, but the Maryborough station does not come within the scope of the partial development scheme. At the time of writing considerable progress has been made with the erection of the 38-kV lines, which are to be seen in many parts of the country. The main 110-kV transmission line, however, is in a less advanced stage, only about 50 kiloms. (31 miles) of route having at present been covered.

Incidentally, the erection of transmission lines in Ireland does not appear to present anything like the same difficulties that are met with in this country.

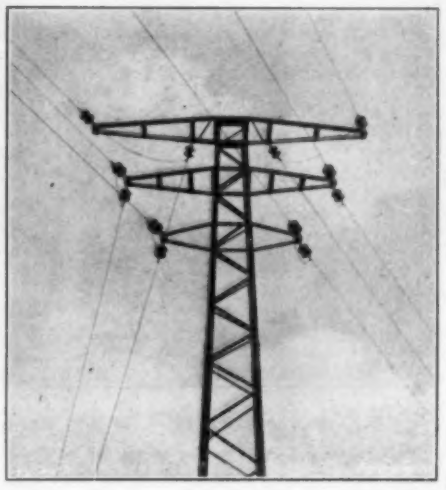


FIG. 5—TOP OF POLE WITH NINE CONDUCTORS

Telegraph and telephone lines are less numerous, and there are fewer rules and regulations to be complied with. The difficulties of obtaining wayleaves also appear to be very much less troublesome than they are in England. Instead of paying landowners an annual rental for poles erected on their ground, the Government has adopted the policy of paying them a lump sum as compensation for all time, and in the event of the land being sold the original agreement with the Government still remains in force. In addition to this fixed sum, paid for the erection of poles, landowners are also compensated for any damage that may be done whilst the lines are being erected. The scheme is based on experience gained

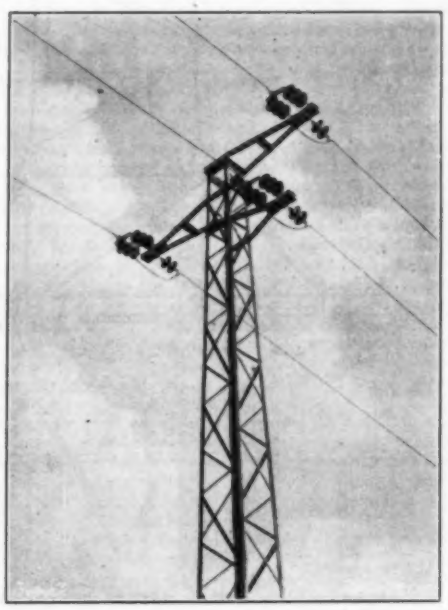


FIG. 6—TOP OF POLE AT RAILWAY CROSSING

in Sweden, which shows that if systematic scales of compensation are established, little difficulty is experienced in settling compensation claims.

At various points on the 38-kV lines transforming stations will be erected, as indicated by the dots on the map, and in them the pressure will be reduced to 10 kV for local networks. Transformer kiosks and pole transformers will be provided at suitable spots for reducing the pressure to 220/380 volts.

The 110-kV outdoor sub-station at Dublin will be situated in the west of the city, and will supply current to the existing electricity works by means of underground cables. Dublin will then derive its supply from the Shannon hydro-station, but apparently the steam plant will be retained as reserve. The 110-kV sub-station at Cork will be erected in the north of the city, whilst Limerick

will be supplied with current through a cable connected to the indoor 38-kV transforming sub-station at the hydro power-house. Special attention is being devoted to places where an electricity supply already exists, and where a direct-current distribution system is in use the question of converting it to an alternating-current system will be considered. In the case of small towns there is not much doubt that direct-current supplies will be abolished, although

FIG. 7—PORTION OF A 38 K.V. SIX-CONDUCTOR LINE

FIG. 8—38 K.V. LINE CROSSING A RAILWAY

in some cases the alternating current may be rectified. Contrary to the American practice of employing widely spreading towers, which require a considerable amount of space and need concrete foundations, the contractors are employing lattice girder masts, as shown in Figs. 5 to 8, as widely adopted in various parts of Europe. All the masts are of square cross section, and concrete foundations are only provided under exceptional circumstances, as, for example, when a tower has to be erected on rock. Experience has shown that girder masts fixed to creosoted wooden sleepers are quite satisfactory, and that the cost of erection is low. For the 110-kV and 38-kV lines steel masts are being mainly employed, but all the poles for the 10-kV lines, which incidentally are not yet being erected, will be composed of wood. About 40 per cent. of 38-kV lines will have wooden poles. In consequence of the damp and relatively warm climate, the steel poles will be subject to rather more corrosion than usual, whilst the wood poles will be liable to more decay. Accordingly, the experts recommended that the steel structures should be designed with sections, rivets and screws of sufficient size to withstand some corrosion, and that the wooden poles should be impregnated with creosote. The experts also recommended that the cross arms of the 110-kV towers extending to Cork, which cannot be painted whilst they are alive, should be coated with zinc by the hot process.

The shortest distance of the lines from the ground has been fixed in accordance with the German regulations. In the case of 10-kV lines it is 6 m. (20ft. approximately), for 38-kV lines 6·5 m. (21ft.), and for 110-kV lines 7 m. (23ft.). In the case of crossings over railways, canals, &c., the measurement depends on local conditions. For the 10-kV lines the span varies according to the cross section from 60 m. to 80 m. (say, 196ft. to 262ft.) on level ground. In the case of the 38-kV lines on wooden poles with suspension insulators, it amounts to from 80 m. to 100 m. (262ft. to 328ft.), and in the case of 38-kV lines on steel towers with suspension insulators, to from 180 m. to 200 m. (590ft. to 656ft.). The span on level ground for 110-kV lines on steel poles is 250 m. (820ft.). In the case of railway crossings with steel towers a span of 100 m. (328ft.) has been taken as a basis, whilst in the case of wooden poles it is 40 m. (131ft.). On these spans the transmission project has been based, and they are being adopted on level ground. All the conductors are composed of the best electrolytic copper with a tensile strength of over 40 kg. per square mm. In calculating the sag a maximum tensile stress of 19 kg. was assumed under the most unfavourable conditions, so that a factor of safety of more than two is attained. A very fair idea of the construction of the 38-kV lines can be gathered from Figs. 5 to 8, which show the top of a pole supporting six main lines and a three-wire branch line, the top of a pole at a railway crossing, a straight six-conductor line and a line crossing a railway. In crossing railways the precaution taken in order to prevent wires falling is to reduce the stress in the conductor by making the span shorter, and to attach each wire to two chains of insulators with an additional insulator in each chain. The conductors over the crossings have a factor of safety of 5. A 110-kV pole is shown in Fig. 10, whilst the drawing, Fig. 9, shows the method of attaching the poles to the wooden sleepers.

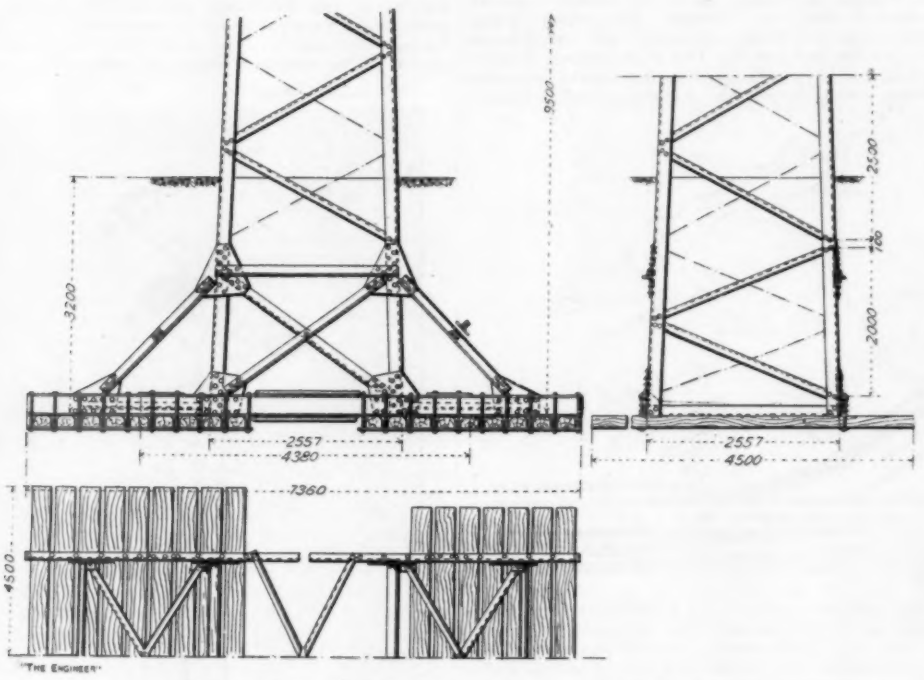


FIG. 9—METHOD OF MOUNTING MAST ON WOODEN SLEEPERS

In concluding this first article on the Shannon power scheme, it may be mentioned that, whilst in this country some seem to imagine that the agricultural districts are soon going to prove of great boon to the electricity supply undertakings, the experts who were called in to examine the Shannon scheme have assumed that electrification in the agricultural districts will proceed slowly, and that during the partial development period the annual consumption in those districts will only be 8·96 million units per annum, of which about 3 million units are allocated to farmers and the remainder to mills and creameries; whilst when the scheme has been fully developed it may reach 26·79 million units per annum. In Ireland it is apparently considered that for some considerable time to come, at any rate, the demand for electricity will emanate mainly from the towns and other densely populated parts, and that an immediate substantial consumption in Irish agricultural districts cannot be depended upon.

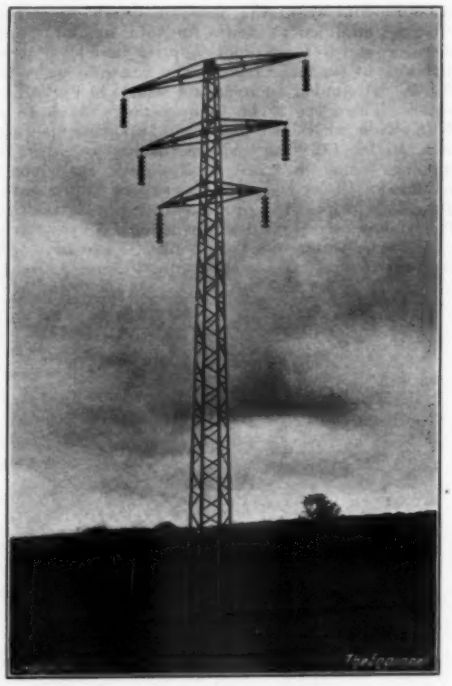


FIG. 10—110 K.V. TRANSMISSION MAST

(To be continued.)

The Institute of Fuel.

No. II.*

FOLLOWING the Presidential Address on Wednesday, November 23rd, reported in our last issue, a paper on "National Electricity Supply—Better Utilisation of our Fuel Resources," was read by Sir Philip Dawson.

ELECTRICITY SUPPLY.

After pointing out the need for dealing with our adverse trade balance, which can only be done by decreasing our imports and increasing exports, Sir Philip said that the improvement of methods of production by means of co-operation, combination, and modernisation were the only means of increasing exports, whilst the production as far as possible of

* No. I. appeared November 25th.

raw materials and semi-raw materials by ourselves, instead of importing them, was the means by which imports could be decreased. On the Continent and in America it was realised that modernisation of industry was synonymous with electrification and that and the process of amalgamation and co-operation of similar productive interests had gone on far more rapidly than with us. The use of electricity had been largely neglected in our coal mining and steel industries, although many individual examples of most efficiently equipped works existed. The capacity of electrical plant in British coal mines amounted to 2·6 kW per 1000 tons of coal extracted, against 6·5 kW in Germany. As compared with the mines of the Pas de Calais our coal mines were only electrified to the extent of 43 per cent., and the total electricity generated in Great Britain in 1925 was 11,000 million units, against 22,000 million in Germany, where 40 per cent. of the electricity was produced by cheap low-grade brown coal. In this country large reserves of coal remained unworked owing to poor quality, but they could be utilised for producing power at the pit mouth. Much of it could be subjected to treatment for the production of oil, the residue being utilised for generating electricity. The British mining industry could not be successful except by linking up the modern methods of power production and fuel utilisation. For instance, in this country much coke oven blast gas, owing to lack of co-operation and co-ordination, was wasted by burning in the open air, whilst none was so wasted in Germany and the United States. The co-ordination of coal mining, by-product plant and generation of electricity would benefit the whole community, but it had been difficult hitherto as electricity supply was an essential part of the scheme. No organisation had existed which would take the electricity so produced and dispose of it, but the formation of the Central Electricity Board had solved that difficulty. Whilst until the passing of the Electricity Act of 1926 the capacity of the many generating plants installed was 62 per cent. in excess of the combined maximum demand, by linking up as provided under the Government scheme that would be reduced to 10 per cent., in addition to which the cost of production would be considerably reduced owing to the better operating conditions resulting.

The discussion was opened by Sir Arthur Duckham, who emphasised the great strides made since the formation of the Electricity Board in the realisation of the ideal set out in the paper, and he expressed the view that the capital expenditure upon the grid system—so often criticised—would be found to be money well spent. Undoubtedly collieries were anxious to dispose of their poorer quality fuels, and something was possible in the way of cleaning. By cleaning coal of lower calorific value—9000 or 9500 B.Th.U.—the value of the smalls might be 1s. or 2s. per ton at the collieries, and if that fuel were powdered it might be available at a sufficiently low cost to justify its use in the generation of electricity and for the Central Board to purchase that electricity. Sir Arthur commented on the fact that in the Clyde area—the Central Board's first scheme—not one colliery had suggested that it should supply current to the Board as part of the scheme.

Sir William Larke referred to the difficulties of obtaining wayleaves for erecting transmission lines in this country and, incidentally, expressed the view that protective arrangements under overhead lines were more likely to be a source of danger owing to their weight, than of safety. A change of legislation as regarded wayleaves was necessary. He also urged the application of scientific salesmanship in selling electricity for power purposes, because there was, he said, still too great a tendency to regard the matter from the point of view of capital cost instead of from that of increased efficiency.

Sir Richard Redmayne recalled that in his Presidential Address to the Institution of Mining and Metallurgy in 1916 he had made suggestions similar to those contained in Sir Philip Dawson's paper, and that in the following year he had induced the Government to set up a Coal Conservation Committee. Recently he had been studying the amalgamation of collieries in various areas and was convinced that a very great economic advantage would follow. Sir Richard spoke strongly in favour of pulverised fuel, and claimed that it had all the advantages of oil as regarded convenience, cleanliness, absence of ash, and reduction of labour, and yet was cheaper than oil in many cases. For instance, the cost per day of running one of the Canadian Pacific vessels between Southampton and America was about £200 when using oil, but it would not be more than £50 or £60 per day when using pulverised fuel. The only trouble was to avoid the possibility of spontaneous combustion of pulverised fuel, but he prophesied that in a very few years cargo and even passenger vessels would be using pulverised fuel and steam in the neighbourhood of 700 lb. per square inch, and that the use of oil for generating steam would have been abandoned.

Mr. W. M. Selvey suggested that the principal trouble in the reorganisation of the coal industry was finance. There were many fine examples of modern colliery equipment in this country which the world did not know about, because it was not our habit to advertise. It was not right to say that we had done nothing. At the same time, it was well that Sir Philip should spur us on. The position at the moment was that the collieries could not dispose of all their high-grade fuel, and therefore they were bound to hesitate before spending capital upon plant to treat the lower-grade coals.

Mr. Roger T. Smith said that it was not a correct inference for Sir Philip Dawson to draw that because it was good for countries using water power to interconnect their power stations it was necessarily so for this country where we had so much coal. It was absolutely essential for water power stations to be interconnected to ensure continuity of supply, and the fact that the difference between the cost of generation in small stations and some of the large stations contemplated was nothing like so much as some people imagined, must not be overlooked. The real need here was a concentration upon a better selling organisation in the electrical industry and a greater reduction in the cost of distribution. At the same time we must not err in the manner that they had on the Continent, where overhead lines had been put up with a degree of insecurity which could not be tolerated here.

Sir Philip Dawson briefly replied to the discussion. He agreed that concentration upon selling electricity to a greater extent than had been the case here in the past was very necessary. The existing overhead line regulations were unnecessary and far too rigorous, although he agreed with Mr. Roger Smith that we should not go to the other extreme.

High-pressure Steam.

The next paper was entitled "Operating Experience of Steam Production at 1300 lb. Pressure," by Mr. J. Anderson, of Milwaukee. This paper, which we reproduced in our last issue, was presented by Mr. W. H. Patchell, in the absence of the author. The discussion upon it was postponed until the afternoon.

Mr. W. H. Patchell also opened the discussion by giving the following further information concerning the boiler referred to in the paper. He said that in 1920 the standard capacity of the boilers in use at Lakeside was 72,000 lb. per hour, but in 1924 it had been increased to 112,500 lb. per hour, whereas the boiler referred to in the paper had a capacity of 240,000 lb. per hour. It was a three-drum Stirling boiler built for a pressure of 1390 lb., and it had 38,530 square feet heating surface, the tubes being 3in. outside diameter. The side walls of the furnace formed a radiant heat superheater of 930 square feet, and the rear walls of the reheater had 937 square feet heating surface; the front wall of the furnace was made of fin tubes and had an evaporative surface of 458 square feet. The air heater plate type heated the secondary air to 660 deg. Fah., the water screen in the bottom had a surface of 532 square feet, and the riser tubes a surface of 552 square feet. The CO_2 was 16½ per cent., but Mr. Anderson had run for a short time at 17½ per cent. The high-pressure machine was a twenty-stage impulse turbine, the wheels being integral with the shaft which was made from a nickel steel forging.

Mr. F. H. Rosencrants, speaking with reference to the permissible temperature of preheated air which might be utilised with stoker firing, said that most of the discussions on that subject had been made with reference to the maintenance factor as applying to stokers and furnaces, and it had commonly been assumed that there was no alteration from the combustion point of view. It had been learned recently, however, that the temperature of preheated air which could be utilised successfully might also be limited from a purely combustion point of view. In the present case, for instance, it had been found that up to a certain rating with the stoker, combustion conditions were quite satisfactory, but beyond that rating the fire began to break up, and in a very short time the fuel bed was in a most unsatisfactory condition. The air temperature was of the order of 500 deg. Fah., and the grate temperature as it passed under the coal hopper, was also in the neighbourhood of 500 deg. Fah. During a period of experimenting to solve that problem it was suggested that the grate should be cooled before it passed back into the furnace, and as a temporary expedient a spray of water was applied to the grate as it passed over the sprocket at the point where it entered the furnace. The result was indeed remarkable. Immediately that was done, a perfect fire issued from the feed gate in a straight line and combustion conditions were excellent. An unsatisfactory condition again developed immediately the spray was shut off. The same thing had been tried with stokers of different makes, always with the same result. It was not known yet, however, whether the same action would take place with all kinds of coals. With the progress in perfecting stoker design, he believed that much higher temperatures than were commonly in use might successfully be adopted. The successful handling of stoker riddlings was also a point carefully to be considered, since with high air temperature any considerable accumulation of riddlings in the air compartments became a menace as regarded spontaneous combustion. The furnace would require some positive means for cooling the side wall and water cooling must be applied with discretion. The arch, too, demanded some consideration, and water circulation might be effective, but, at the same time, it might prove a delicate design. As regarded the use of preheated air with pulverised fuel, the use of it in a pulverised fuel furnace with refractory walls was practically suicidal. He did not agree that combustion was so greatly affected by preheated air as the author believed, though furnace turbulence was an equal if not a greater factor in the time element of combustion. At the same time he was prepared to agree that the effect of preheated air on the combustion process was beneficial rather than otherwise.

Mr. Herbert Humphrey (Consulting Engineer, Imperial Chemical Industries, Ltd.) said that he had been to Milwaukee about two years ago to see the plant described in the paper, and added that when he went into the matter of high-pressure steam for the purposes of his group of companies, he came to the conclusion that he would not be justified in going to a pressure higher than 450 lb., for the reason that the conditions were not those of a central power station. He regarded the matter solely from an economical and financial point of view. However, he finally suggested a pressure of 550 lb. in order to provide a margin for the future, although at first it was not possible to utilise the full pressure. More recently he had had to assist in coming to a decision in connection with the installation of another large boiler and the pressure had gone up to 750 lb. The reason was not that the original decision was wrong, but because of the advances that had been made since. It appeared that the total extra capital cost would work out at about 8 per cent. on the total installation, and, moreover, the tendency had been for the prices of high-pressure installations to come down.

Mr. Thomas Roles, Electrical Engineer, Bradford Corporation, said that although there had been many papers and articles dealing with high-pressure steam plants, that was the first giving definite information with regard to operating troubles with such plants. Incidentally, Mr. Roles, with other speakers, paid a tribute to the kindness and courtesy with which Mr. Anderson always received engineers who visited his station and the welcome that was offered to any engineer to do so. On the question of the cost of high-pressure boilers he said we did not yet know what it was going to be, because the makers had not had time to find out their actual costs. It appeared that there would be a considerable increase in cost above 500 lb. pressure, because of the necessity to use forged steel drums. Speaking generally, Mr. Roles repeated what he had said on one or two previous occasions, viz., that unless a power station was operating in a district where the price of coal was very high, he was doubtful whether it would pay to go beyond a pressure of 800 lb. He might be asked, he added, why in that case he had gone to 1100 lb. in his installation at Bradford, and his answer was that, at the time he made the decision at Bradford, it was not known exactly how the prices were coming out. It was not known even yet, and therefore it was thought better to go for 1100 lb. now, because if he extended the plant he could drop to 800 lb. if necessary, whereas had he adopted 800 lb. and then found it necessary to increase, it would have been more difficult. Speaking on the question of disseminating information, Mr. Roles said that the paper was, in a way, a record of failures overcome, and he congratulated Mr. Anderson upon publishing the facts. When an American engineer met with troubles he did not hesitate to let others know, but in this country engineers were too much inclined to keep their troubles to themselves, and thus nobody else got the benefit of the steps taken to overcome them. We were too fond of keeping our troubles to ourselves in this country, and he hoped we should in future adopt the policy of American engineers in that respect. For instance, the North Tees station had been referred to in America as the hush-hush station. That station was running ten years ago as a high-pressure station, and it would have been better for the development of the use of high-pressure steam had more information been published with regard to it. It rather appeared that Mr. Anderson would not have had the troubles he had if he had been more careful with his feed water, and experience at other high-pressure stations suggested that some troubles had been encountered at Milwaukee through using pulverised fuel, although he was not personally against the use of pulverised fuel. Mr. Anderson also appeared to have had considerable trouble in connection with the tubes in his water wall and the very great heat transmission rates in his furnace. So far as the Bradford plant was concerned, it would have chain-grate stokers, and the tubes of the boiler would be well above the grate. There would be water walls, but not a radiant heat superheater. He certainly should endeavour not to use the same kind of water as Mr. Anderson did, and as the Bradford plant would be the first high-pressure commercial plant to be worked in this country with steam at over 1000 lb., he expressed his sincere thanks to Mr. Anderson for having written his paper and for the information contained. Later he hoped to be able to publish the results obtained at Bradford and hoped they would be of value.

Mr. J. P. Chittenden also thanked the author for his frankness in giving details of his troubles with his high-pressure plant. At the same time, he said he had a little quarrel with the author because he had devoted all his remarks to the boiler and its attendant troubles and had given no information as to the general operation of the station. It certainly, therefore, would be interesting if Mr. Patchell could give some information on that point. The Milwaukee plant could be described as a superposed plant, *i.e.*, a high-

pressure plant working in conjunction with a normal-pressure plant. That was one of the most interesting problems in high-pressure steam development. That line of development would be the means of giving a new lease of life to many stations in this country, and it would also be the means of obtaining higher thermal efficiencies in a much cheaper manner than by putting down larger stations with new plant.

Mr. John Bruce (Barking Power Station), who promised a detailed discussion of the paper in writing, said that the troubles experienced by Mr. Anderson with feed water were exactly similar to those which had been experienced in his station. Those troubles, however, had now been overcome, and with a low oxygen content—from 0·2 to 0·5—corrosion did not take place.

Dr. T. Barratt said that the measure of success obtained by Mr. Anderson was indicated by the statement in the paper that an order for an additional 1300 lb. boiler had been placed. Referring to the fact that the author, in discussing the effect of scale, had assumed that the thermal resistance of scale was 7½ times that of metal, Dr. Barratt said that the only authentic figures he could find on that question (Bidwell, *Physical Review*, 1917) gave the thermal conductivity of iron oxide as 0·0012 at 150 deg. Cent. to 0·0039 at 1050 deg. That made the thermal resistance of scale 40 to 125 times that of iron.

Dr. J. A. Leasing, who presided during the discussion, showed some lantern slides illustrating the actual plant at Milwaukee, and mentioned that Mr. Anderson was also a pioneer in several other directions, one of which was powdered fuel firing.

Measurement of Steam Flow.

Following the discussion on Mr. Anderson's paper, a paper by Messrs. H. C. Armstrong and T. Nordenson on "The Measurement of Steam Flow in Works Practice" was taken. This paper was divided into two parts, the first of which was devoted to a discussion of the necessity for measuring steam used in works of all kinds, whilst the second part indicated a practical method of so doing. This method involves the use of a portable meter or a differential manometer and a special orifice. The apparatus is designed to work on the well-recognised principle that the drop in pressure of a fluid flowing through an orifice inserted in a pipe, owing to the constriction of such an orifice, is proportional to the quantity flowing, and a special diaphragm, which has been used by the authors, is described. This orifice diaphragm fitting can be made in any workshop and be fitted in any steam pipe in a short time with a minimum of interference in the shop working.

Preheated Air for Boilers.

The final paper of the day was one entitled "Preheated Air for Boiler Furnaces," by Mr. P. H. N. Ulander. The author pointed out that the first application of preheated air for boiler furnaces took place some 150 years ago, and that during the last forty years the majority of marine boilers have been fitted with air heaters. For land installations, however, the idea had not been favourably received, generally speaking. The reason for that antipathy was that engineers in charge of large boiler plants were fearful of the effect on the furnace linings of their boilers. The trend of modern development in turbine and boiler design had, however, fundamentally altered the position, and to-day the air preheater was being recognised as a necessary adjunct to the boiler. Mr. Ulander argued that the tendency of the future would be for an increasing number of air preheaters to be installed in conjunction with economisers of decreasing size. Moreover, it was fairly safe to assume that the trend of development would be towards an increase in the exit temperature of the flue gases from the boiler, and that with the collateral rise in feed temperatures the installation of an air preheater of high thermal efficiency would be essential.

The Coking Industry.

The first paper to be taken on Thursday morning, November 24th, was one by Mr. Robert Ray, and was entitled "The British Coking Industry and Some of its Products." The author points out that for the production of a suitable blast-furnace coke at a price which would leave a profit for the producer and, at the same time, enable the ironmaster to compete on fair terms with the Continent, amalgamations of coking interests in certain areas must be brought about. That would mean the production of coke in large centralised batteries of coke ovens of a minimum capacity of 1000 tons per day instead of in the many small out-of-date and uneconomical plants operating to-day. The paper contains figures to prove the financial advantages of such a policy. Among the essential conditions for such a change is the use of aerial ropeways to reduce the present high freight charges to facilitate the transport of coking slacks to a central market. The need for disposing of the high calorific gas produced is emphasised, and attention is drawn to the common practice on the Continent of disposing of it to electricity generating companies and large industrial concerns. The paper also indicates how properly graded coke could be supplied, and deals with the development of coal-cleaning methods.

The discussion on this paper revealed a general consensus of opinion that the proposals outlined are sound in principle, but, at the same time, extremely difficult to put into practice. One speaker went the length of almost deploring that some of our blast-furnaces did not suffer the fate of some of those in Belgium and France during the war. Then we could have started *de novo*. Another point made was that coke oven managers need to be converted to the amalgamation idea.

In a paper on "Vertical Intermittent Chambers Ovens," Mr. N. J. Bowater described the developments that have taken place during recent years in Germany in the vertical intermittent chamber oven system of coal carbonisation. Although at first sight the adoption of this type of oven might appear to be a retrograde step, the author urged gas managers in this country to give it serious attention in view of what has taken place in Germany.

The discussion showed that British gas engineers are taking a keener interest in these ovens than they used to, and that as the result of visits to Germany to investigate what one speaker said were thought to be "travellers' tales" of the wonderful results that were being obtained, some orders have been placed by this country for such plants. At the same time, certain criticisms were made of the vertical intermittent chamber oven from the technical point of view.

The final paper on Thursday morning was one by Professor M. W. Travers, F.R.S., entitled, "The Chemical Study of Processes Involving the Carbonisation of Coal by Internal Heating."

Oil Fuel.

On Thursday afternoon two papers were read dealing with oil fuel, one by Dr. A. E. Dunstan and Dr. H. G. Shatwell dealing with the general question of oil fuels other than petroleum, and the second being by Mr. J. Ivon Graham and Mr. D. G. Skinner, which dealt specifically with the Bergius method of obtaining oil from coal by means of hydro-generation. These papers covered more or less familiar ground, but they served the purpose of drawing from Dr. C. H. Lander, the Director of Fuel Research," an interesting account of the manner in which the British nation, through the Department of Scientific and Industrial Research, has obtained an interest in the Bergius process at an extremely low figure, after many hundreds of thousands of pounds have been spent on it on the Continent. A full scale plant is now being tested at the Fuel Research station at Greenwich, and the public will be kept in touch with the work through the usual channels.

The impression made on the minds of some people present was that Dr. Dunstan—who, of course, is associated with one of our large oil companies—rather suggested that with petrol at its present price there is not so much incentive to proceed with development on other methods of obtaining oil. Doubt, however, was thrown on the prospect of petrol prices remaining as low as they are for many years, and, therefore, it was urged that we should press forward in every possible manner with efforts to obtain new sources of fuel oil. The somewhat ironical comment was made that only a few years ago an American Commission reported that in a very few years the natural supplies of oil would seriously diminish, and yet at the moment the supply is greater than the demand. This state of affairs was attributed to keenness in searching for new wells and also to research.

It may be said that the rights of the Bergius process have been obtained for the British Empire and Portugal, and lest some people should wonder why Portugal has been included, Dr. W. R. Ormandy explained that Portugal cannot do much without British funds, and that there are some valuable deposits of coal in Portuguese East Africa to which the process might very well be applied. Incidentally, it was mentioned that the original patent of Bergius cannot now be taken as a correct description of the process as carried out to-day.

Hydraulic Power Developments in British Columbia.

Vast sums of money are being expended by the British Columbia Electric Railway Company in improving and extending its hydro-electric distribution system on the Canadian-Pacific coast. A huge construction programme is at present under way, and future plans call for the expenditure of many millions of dollars.

The Pacific Coast of British Columbia, just north of the international boundary line between the United States and Canada, is known as the lower mainland of British Columbia. It is within this territory, as well as in the southern part of Vancouver Island, that the company and its subsidiary companies supply electric railway, light, power and gas services. The operations on the mainland are carried on in an area of about 80 miles from east to west and 40 miles from north to south. There is no interconnection between the mainland and the island systems, nor is any practicable on account of the intervening water distance.

The records of the use of power on the mainland point to vigorous and sound future growth. Company engineers recently predicted an annual incremental increase in total load approximating 10 per cent., equivalent to a doubling of energy output for each period of about ten years in the future. The present hydro-electric generating capacity of all the plants of the mainland system, including plants under construction, is 123,325 kVA. The doubling of this capacity by 1934 will mean an expenditure of some 25 million dollars in new plants, transmission lines, substations, &c.

The power used by the British Columbia Electric Railway Company and that sold to its customers is generated by and purchased from subsidiary companies, viz., the Vancouver Power Company, and the Western Power Company of Canada, Ltd., on the British Columbia mainland, and the Vancouver Island Power Company, Ltd., on Vancouver Island. The hydro-electric power plant of the Vancouver Power Company is at Lake Buntzen, 15 miles from Vancouver. Water from what is known as the Coquitlam watershed is diverted into Lake Buntzen through a tunnel, and is utilised in two generating stations situated on the north arm of Burrard Inlet. Plant No. 1—Fig. 1, page 630—first operated in 1903, and completed in 1912, has a total generator capacity of 28,200 H.P. in seven units. Plant No. 2—Fig. 2—completed in 1914, has a total generator capacity of 35,800 horse-power in three units. The Jordan River plant—Fig. 3—from which the company obtains most of the power for its operations on Vancouver Island, is situated at the mouth of the Jordan River, which flows into the Straits of San Juan de Fuca at a point 37 miles west of the city of Victoria.

Bridge River Project.

The principal interest at the moment centres in what is known as the Bridge River project, which includes the boring of a rock tunnel 13,200ft. long. The contract for the boring of this tunnel was recently awarded to Pacific Engineers, Ltd., of Vancouver, for 1,249,530 dollars. According to an estimate made by George Kidd, president of the British Columbia Electric Railway Company, the job will cost about 2 million dollars when details, not included in the contract, are considered. Work on the 2½-mile bore has already been started. The contract calls for completion within 1000 days, which period will elapse in August, 1930.

The actual site of the Bridge River project lies at Bridge River Station on the Pacific Great Eastern Railway, approximately 105 miles north-east of Vancouver, the power-house being placed on the shore of Seton Lake. The Bridge River valley lies about 2½ miles to the north and some 1200ft. above Seton Lake. The river drains the eastward slopes of the coast mountains and flows in a general easterly direction into the Fraser River at a point about 5 miles north of Lillooet, B.C.

In a nutshell, the Bridge River project consists of diverting the waters of Bridge River through a tunnel into Seton Lake, and utilising the head thus made available for the production of hydro-electric power.

The initial development will consist in the utilisation of an average flow of 575 c.f.s. under an effective head of 1152ft., producing approximately 63,000 horse-power. The main elements comprised in the first installation will be:—Diversion dam on Bridge River; 12ft. tunnel with intake, surge chamber and outlet; two penstock lines from the tunnel outlet to the power-house; power-house building housing two 20,000-kW hydro-electric generating units; and a single-circuit transmission line connecting the generating plant to the system of the British Columbia Electric Railway Company at Vancouver.

As soon as the growth of load warrants the production of additional power, a third unit similar to the first two will be added. A third penstock, an extension to the power-house building, and the installation of the hydro-electric machinery are all the constructional features which will be required in connection with this third unit. With the completion of the third unit the plant will have an installed capacity of 60,000 kW. The average output, as limited by available water, will be approximately 45,000 kW, so that the plant will operate on a 75 per cent. load factor.

The next stage after the initial equipment will include the development of additional storage, either by building the ultimate dam at Dam Site No. 7, or by building a dam on the upper basin at La Joie Falls, the driving of a second tunnel, 14ft. 5in. diameter, parallel with, and approximately 400ft. west of the initial tunnel. The development of this stage will also call for the extension of the power-house building westwards, and the installation of hydro-electric units, together with their penstocks to bring the total installed capacity of the Bridge River plant up to 240,000 kW.

For the ultimate development the remaining storage sites will be utilised. The first tunnel will be enlarged to a diameter of 16ft. 6in., and the power-house building be extended to the east. Additional hydro-electric units will be added to bring the total installed capacity of the plant up to the neighbourhood of 440,000 kW, or say 600,000 horse-power. The average output, utilising a continuous flow of 3000 c.f.s. under an average effective head of 1300ft. will be approximately 370,000 horse-power.

The intake of the tunnel will be about 2 miles upstream from the dam, this point affording the shortest tunnel distance through the Mission mountain range to Seton Lake. The intake structure will consist of

a circular concrete tower with water passages through the base leading up into the interior of the tower and thence to the tunnel. The closing of the water supply to the tunnel will be accomplished by lowering a plate steel cylinder, 20ft. in diameter, over the openings in the base of the tower. This will allow the water to rise to reservoir level within the cylinder, but will leave the interior of the tower, outside the cylinder, dry. Since the forces exerted by the water on the cylinder are balanced there is no resistance to the inclosure of the valve. This is a type of valve which has been successfully used on a number of projects where it has been necessary to control intakes handling large quantities of water.

The surge chamber will be in the form of an enlargement of the tunnel and will be circular in cross section, being lined throughout with concrete. A circular shaft approximately 7ft. in diameter will extend from the surge chamber to the ground surface.

Leading from the surge chamber will be a short section of pressure conduit, approximately 9ft. inside diameter, formed by the reinforced concrete tunnel line. The pressure conduit will connect with a riveted steel pipe of the same inside diameter. For a distance of 50ft. to 75ft. the tunnel outside of the steel pipe will be entirely backfilled with the pressure conduit. The remainder of the pipe to the portal will be in open tunnel.

The other outstanding features of the system are the Stave Falls and Alouette developments, and the proposed Ruskin development.

The Alouette Development.

The Alouette Lakes lie in a narrow valley about 8 miles north of the Fraser River and about 25 miles due east from Vancouver. They are drained by the Alouette River, which, after flowing south-westerly about 15 miles, discharges into the Pitt River at tidal elevation. At low water there are really two lakes separated by a short stretch of running stream, but, with the water level raised, the two merge into one. The lakes lie at an elevation about 140ft. above Stave Lake and about 370ft. above mean sea level.

The raising of the level of the Alouette Lakes by building a dam at their outlet, thereby affording storage to regulate their waters; the piercing of a narrow granite rim with a tunnel to divert the waters into Stave Lake; and the installation of a generating plant at the outlet of the tunnel to recover the energy of the falling waters on their way to the lower levels to Stave Lake are the essential features of the Alouette project.

Strictly speaking, the site of the dam possessed few conditions to recommend it as a dam site. A profile along the axis reveals a trough-like depression some 150ft. wide and 35ft. deep, through which the river had its channel. The banks rise abruptly from the river, and the trough is flanked on either side with gently rising terraces which merge into the steeper slopes of the adjoining hills. The entire area was covered with an exceedingly heavy forest growth. The west terrace is plentifully scattered with odd boulders, but these are rare on the east side. To meet the conditions imposed by the site, a dam of the earth-filled type with exceptionally broad base and separate spillway was determined upon. The slopes of the dam are very flat, thus providing the broad base to reinforce and blanket the none too generous layer of underlying clay, and affording conservative slopes for placing the clay fill, the behaviour of which, under the construction methods used, could not be definitely predicted.

The employment of monitors for spreading the dump material proved most effective and economical, and had the distinct advantage of thoroughly working over with water all the materials going into the dam. Under the ordinary methods of semi-hydraulic filling by dumping from trestles or dry spreading, and with the hydraulic action on the inside slopes only, a considerable portion of the resultant fill is placed dry and remains so throughout the work, generally resulting in settlements and possible cracking of the slopes. By the method used at Alouette this condition was entirely avoided. The settlements observed during the construction period and after completion were remarkably small. The diversion of the Alouette River during the construction of the dam was made through the Alouette Tunnel, which was not sufficiently completed for this purpose until June, 1925.

A separate concrete-lined spillway with control gates and overflow weir carries the flood waters around the westerly end of the dam and conducts and discharges them into the river some 200ft. below the downstream toe. The drop of the water from the spillway level down to the stream bed, a distance of about 38ft., was accomplished by an ogee section at the end of the spillway. The excavation was shaped to the required form and a reinforced concrete covering, consisting of longitudinal and transverse ribs with a 15in. slab, was placed directly on the excavated surface of the clay.

From Alouette portal and intake, on the westerly shore near the upper end of the upper lake, the tunnel extends in an easterly direction for 3539ft. before reaching the head gate of the short penstock leading to the power-house. The tunnel bore traversed, in the main, a solid granitic formation affording excellent stability of section and good drilling and breaking qualities. At frequent intervals, fractures or seams, heavily water bearing, were encountered, but they were of little consequence except as a matter of the minor delay and inconvenience attending them. The tunnel proper terminates at the penstock gate shaft where the caterpillar gate controlling the flow through the penstock is set. The penstock continues on in tunnel some 250ft. further to the power-house.

The power-house is set in the steep rocky hillside adjoining the west shore of Stave Lake, some 10½ miles north of Stave Falls, the only approach to it being by water from Stave Falls. The building, as designed, is of reinforced concrete construction, massive but pleasing in appearance. On the south side, adjoining the building, a level space 40ft. by 40ft. is provided as a switch yard and at the north end a similar space, 30ft. by 100ft., forms a material yard. Both spaces are formed at the expense of considerable rock excavation and concrete retaining walls along the lake shore.

Stave Falls Development.

The initial development of the Stave Falls project consisted of the intake dam, the sluice dam and the Blind Slough dam—all raised to a height to permit storage in the lake to elevation of 318—control works and penstocks for four 8825 kVA generating units, three of which were installed.

The improvements and additions undertaken in 1922 and completed in 1925 included as a first step the installation of the fourth generating unit followed by the raising of the intake dam, the construction of the west wing wall, the Blind Slough dam, and the filling in and raising of the sluice dam, all to a level to permit storage to be carried to elevation 340—a net raise of 22ft. in the former storage level—and the installation of a fifth generating unit with the necessary penstock, extensions in power-house building, tail race, &c.

Stave Lake as it stands to-day, with its water level at elevation 340 (269ft. above mean sea level) is a beautiful body of water some 17 miles in length and 1½ mile in width, lying 35 miles east of Vancouver and, with the upper river feeding it and the lower river joining it to the Fraser River at Ruskin, forming a drainage system some 60 miles in length. The original lake terminated about 7 miles above the falls, where the plant is built. The river at this point separated into two channels forming an island between them and dropped over a series of falls some 80ft.

The intake dam, power-house and tail-race occupy the westerly channel, and the sluice dam or main dam the easterly or main channel. A quarter of a mile further east and separated from the main channel by a high rocky hill, is a third channel known as the Blind Slough. This latter channel is some 20ft. higher than the others, and did not function as an outlet, but was closed by ancient log jams and beaver dams; hence its name. The Blind Slough dam now closes this old channel, which is used to carry away the flood overflow from the lake.

The intake dam which closes the westerly channel of the river lies about 200ft. upstream from the power-house, and in it are set the intake gates, screens and other control structures for the proper supplying of four of the main penstocks, and the two exciter penstocks. The original dam, constructed by the Western Power Company in 1911, was a full gravity section concrete structure about 55ft. maximum height, 160ft. long, and was designed to accommodate high lake level of 318ft. with a freeboard of 7ft.

The new main dam was formerly the sluice dam of the first builders, and as such was designed to discharge the entire flood of the river. With the raising of lake level, the Blind Slough became available for this purpose, and the sluice dam was consequently filled in and raised to the proportions of a solid gravity section concrete structure, with crest level at elevation 345. The old sluiceways, five in number, were 22ft. in width, and were separated by concrete piers 8ft. thick. The sluiceways were closed with timber stop logs. In the new structure a roadway 16ft. wide is provided on the crest. This road is connected with the west wing dam by a steel truss span 135ft. long, bridging the intake bay in front of the penstock gates.

One of the most ingenious features of the main dam is the shingle-bolt chute for the passage of bolts, which are produced in large quantities on the lake, through the dam and into the tail-race below the power-house at all stages of lake water level. This feature has proved most efficient in its operation. With a water supply of 25 cubic feet per second, 10,000 bolts have been put through the chute, flume and tunnel and discharged into the tail-race in eight hours' time.

The four penstocks for the original units are 4ft. 6in. inside diameter and 190ft. in average length. The upper ends, which are embedded in the concrete of the intake dam, are belled out to a diameter of 19ft. The plates at the upper end are ¾in. thick, and at the lower end ⅞in. thick. Circumferential seams are double riveted and longitudinal seams triple riveted. Every alternate circumferential seam is stiffened with a heavy angle ring riveted on. The penstocks are supported up to their centre lines in concrete for the greater part of their length. A heavy continuous concrete anchor block encases all of them at the power-house wall. There are two separate 46in. steel penstocks provided for the exciter turbines. The penstock for the fifth unit has its intake in the main dam, and hence must cross the other four main penstocks and the two exciter penstocks to reach the location of the unit at the westerly end of the power-house. It is 20ft. in diameter at the intake and tapers uniformly to 13ft. diameter at the butterfly valve at the power-house wall.

The power-house building—Fig. 4—is of reinforced concrete, 100ft. wide, and, with the addition for the fifth unit, 215ft. long. It is set in the bed of the westerly channel, some 200ft. downstream from the intake dam. The foundation rests on bedrock. Some 58,000 cubic yards of rock excavation was required in preparing foundations for the building and the machinery.

The Ruskin Development.

The site of the Ruskin development lies at a point on the Stave River, about 3½ miles downstream from Stave Falls and near the junction of the Stave River with the Fraser River. After meandering through the terraced valley below Stave Falls, the river has cut its way deeply through a rock barrier that once blocked its course, and from which it debouches into the flood plain of the Fraser at little above tidal level. The lower section of the gorge thus formed affords the site for the development.

While the water rights for the project have been held and maintained by the company for many years, no particular or detailed study of the structures required for its development nor their cost had been made until recently. The site has now been thoroughly surveyed, explored by test borings, and preliminary plans for a scheme of development have been made. The site has no contributing watershed as such, its water being drawn from the tail water of the Stave Falls plant, 3½ miles upstream. Its reservoir will function only as a forebay to regulate these waters. Only daily regulation will be possible. The average water supply is therefore taken as 4200 cubic feet per second. The head available will be limited to that created by the dam. No falls or rapids of any consequence exist at the site. The high water level of the Ruskin reservoir will nominally conform to the tail-water level of the Stave Falls plant, which is 210.

The forebay storage lake formed above the dam will be about 700 acres in extent. The Stave Falls plant under full load will discharge into the forebay at the rate of about 7100 cubic feet per second. The four Ruskin units will draw under full load at the rate of about 9100 cubic feet per second. The excess of draught over input will result in drawing down the forebay level at peak load periods at a maximum rate of about 3in. per hour. Under normal operation of two-hour peak load period, the variation in forebay level will be slight; a twelve-hour peak operation would not lower the water more than 3ft. With assumed overall plant efficiency of 84 per cent., the 4200 cubic feet per second available at Ruskin should be capable of generating 37,000 kW continuously, and the annual energy output is estimated at 328,000,000 kWh.

The main dam as planned is a concrete structure, gravity section, crest overflow type, with ten bays of regulating gates set between piers supporting a deck 31ft. wide which carries the gate-operating gear and a roadway. The foundations will rest on the granite bedrock of the gorge. Some 35,000 cubic yards of boulders, loose rock and top bedrock will be excavated to prepare the foundation for the reception of concrete. The excavation will have a maximum depth of 35ft. The dam proper is estimated to contain approximately 87,000 cubic yards of concrete. The aggregates will be obtained by dredging and pumping from the foreshore in front of the power-house and distant about 1500ft. from the dam. Ten crest gates, with 25ft. clear opening and 21ft. in depth, are planned to control the flood overflow. The gates will be of the Stoney roller type, with head frames and operating gear set upon the main deck.

The four penstocks for the ultimate plant as planned will be riveted steel pipes with an average length of 225ft., and inside diameter of 19ft., and will be ⅝ in. to 1⅛ in. plate, butt jointed and provided with stiffening rings of angle iron as required. The hillside will be excavated to an extent which will permit the placing of the pipes on bedrock. Some 9000 cubic yards of rock and 15,000 cubic yards of earth excavation will be necessary for this purpose. The pipes will be supported on concrete piers and anchor blocks.

Only a rough preliminary design of the station building, sufficient for close estimating purposes, has been prepared. It is designed as a combination steel-frame and reinforced concrete building of sufficient size to house the four proposed units. It will consist of a generator room, 48ft. by 265ft., with floor level at elevation 103, fronting the tail-race. Immediately behind the generator room, a two-storey bay, 18ft. wide, extends the full length of the building. The lower storey is designed for low-tension use and the upper for switchboard purposes. Behind this bay the transformer bay, 25ft. wide, extends the length of the building. Outdoor type transformers are placed on the upper deck of the bay, the space beneath being intended for storage. The rear bay, 34ft. by 265ft., will be used for high-tension switching, buses, and supporting steel structures. The transformer and switching bays are not to be enclosed.

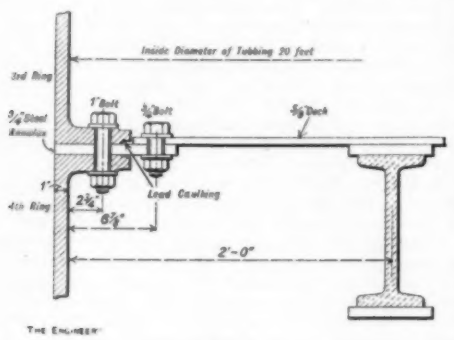
Two Diesel engines of 550 horse-power each are being installed to provide power for the new copper and zinc mine at Desmeloizes in Northern Quebec.

The Deptford Shaft Sinking Accident.

THE official report on the accident which occurred on January 7th last, in the course of sinking a shaft at the London Power Company's Deptford Power Station, has just been issued by the Home Office. The accident, it will be remembered, unfortunately resulted in the loss of five lives, and was at first attributed to an explosion within the shaft; but the report makes it plain that the real cause was the structural weakness of the tubbing used to line the shaft. The shaft was being sunk as a preliminary to tunnelling under the Thames, with the object of obtaining a supply of circulating water, and it was necessary to use air pressure to keep the workings dry. The shaft was consequently decked over to retain the air pressure, and it was the method of connecting the deck to the tubbing which caused the accident.

The report has been drawn up by Messrs. R. U. Shaxby and L. C. McNair, H.M. Inspectors of Factories, and includes appendices by Messrs. Burstall and Monkhouse, Dr. Lowe Brown, Professor Coker, the National Physical Laboratory, and Mr. W. Rae. In view of the fact that the report covers thirty-three closely printed pages, it is impossible to do more than summarise it here; but the essential features are illustrated by the sketch which we have prepared from the official drawings, while it is unnecessary to refer to the alternative causes of the accident investigated and rejected as being untenable.

The shaft, which was sunk through made ground and sand to a depth of 51ft., was 20ft. in diameter. It was lined with cast iron tubbing in segments about 5ft. long by 3ft. deep and 1in. thick, with 6in. flanges 1¼in. thick. The flanges were machined and bolted together by 1in. bolts. Between the third and fourth rings of tubbing, counting downwards, a steel annulus ⅜in. thick was inserted in the joint and projected inwards—as shown in the cut. This annulus was used for the support of the



METHOD OF CONNECTING DECKING TO TUBBING

decking, which was of ⅜in. plating supported by four main girders about 2ft. deep. The whole of this decking was bolted to the steel annulus by a ring of ⅞in. bolts and an air-tight joint was made by caulking lead into the space between the annulus and the flange of the tubbing above it. It may consequently be assumed that the upward thrust of the air pressure was transmitted to the inner edge of this flange, and that some of it was borne by the flange below, as the two were bolted together. The air pressure used was about 13 lb. per square inch, which gave a total upward thrust of some 250 tons, but from this there must be deducted the deadweight, bringing the net thrust to approximately 200 tons. This load, if applied normally, would produce a tension in the tubbing immediately below the deck of ¾ ton per square inch, a tension which cast iron should safely withstand. The tubbing, however, cracked right round just below the deck, which was projected upward by the air pressure. The shaft was more or less wrecked, and the men were drowned by the inflowing water.

Investigations showed that the tubbing segments were quite reasonably good, according to ordinary standards; but a test of a 6in. wide section, made by Messrs. Burstall and Monkhouse, showed that it only required a load of from 3 tons to 4 tons to break the specimen in tension when the load was applied at the bolt holes of the flanges. The material had a normal tensile strength of from 6·6 tons to 7·3 tons, so that the specimen should have resisted a total stress of about 40 tons if applied as pure tension. In actual fact the conditions were probably more severe than this test as, as has already been mentioned, the load may be taken to have been applied at the inner edge of the flange, while the load must have been concentrated at the ends of the cross beams. These beams were so spaced that they came between the vertical flanges connecting the segments of the third ring of tubbing, so that the horizontal flange received little support from them in carrying the load.

Experiments carried out by Professor Coker on transparent models with polarised light showed plainly that in such circumstances there would be intense local loading of the tubbing just below the horizontal flange, and it is assumed that this load caused a progressive failure of the whole ring.

Throughout the report it is emphasised that the general arrangement of the decking was that commonly used for such classes of work and has given little trouble heretofore; but that unsuspected stresses were set up by it in the material of the tubbing. A number of safeguarding recommendations are given, and among those immediately connected with the accident there are the following:—

"A design in which air pressure is balanced by dead load is to be preferred to one in which stresses of unknown amount may be incurred by the structure—particularly if it includes cast iron members. We think it is much better to use steel than cast iron for the first few rings at the head of a shaft of this character. Where cast iron is employed and any portion of it is to be exposed to tension, precautions should be taken during founding to minimise the setting up of internal stresses in the material as the result of unequal cooling. Adequate precautions (such as the provision of sufficient "risers" to serve every angle) should be taken to prevent blowholes being formed in the castings. All the material should be fully up to the specifications of the British Engineering Standards Association. Well-rounded fillets should be provided at corners; strengthening gussets between web and flange are desirable at intervals and the strength of segments can be much enhanced by extra vertical flanges. Where points of special stress occur such as attachment of diaphragms and of deck girders to tubbing, particular care should be taken to distribute the stress and to ensure that it is mostly borne by vertical and not by horizontal flanges."

Modern Portland Cement Plant.*

By HAL GÜTTERIDGE.

(*Concluded from page 610*)

CONVEYING PLANT.

Slurry.—There are five methods in use by which slurry can be handled:—(1) Plunger pumps; (2) centrifugal pumps; (3) elevators and conveyors; (4) gravitation; and (5) air lift.

(1) *Plunger Pumps.*—In this country the plunger pump is most frequently used and takes the form of a three-throw vertical pump with "A" frames. In one type there is a special arrangement to prevent the slurry from escaping through the packing gland. A water seal is arranged by fixing a loose ring under the gland packing with a series of holes or waterways opening out directly to the plunger face, the effect being to wash the plunger and keep a film of water between the slurry that is being pumped and the packing.

(2) *Centrifugal Pumps.*—The use of this type of pump has the advantage that it can be driven direct by a motor, and is compact and light in weight compared with the plunger type, but difficulties in its operation due to attrition of the casings have prevented its use in this country. It should be constructed without stuffing-boxes, a centrifugal seal being provided instead.

(3) *Elevators and Conveyors.*—A form of elevator which is frequently used is a slurry lifting wheel. This is simply a wheel about 30ft. in diameter with buckets, generally of elm, securely fastened to its perimeter. There is little to get out of order and the horse-power necessary to drive it is low.

(4) *Gravitation.*—Whenever possible, the handling of slurry by gravitation is arranged. For this to be effective, the inclination of any chute must be above a minimum depending on the water content of the slurry.

(5) *Air Lift.*—In America, according to Meade,† an apparatus similar in principle to the pulsometer pump is employed. This consists of two receiving tanks set side by side into which the slurry flows by gravity. Each tank is equipped with a float which operates an air valve. The slurry entering the tank raises the float, and when the tank is full the float causes an air valve to open, allowing compressed air to flow into the tank and discharge its contents to the elevation required. This lifting apparatus has the advantage that there are few moving parts, but, on the other hand, it takes up a lot of floor space, must be placed below the level of the bottom of the slurry tanks, and its efficiency is low.

Dry Materials.—The conveying of dry materials can be arranged either mechanically or pneumatically. The types of mechanical conveyors and elevators used in cement making plant are common to many other trades, and do not call for special mention.

Storage of Finished Mixed Slurry.—The finished mixed slurry is contained in large mixers generally with a total capacity of 3½ days' supply for the kilns. These mixers have to keep the slurry in a properly mixed state, and are either of the "sun and planet" type or air-agitated type, both of which have already been described. The total capacity of these mixers for a plant with an output of 135,000 tons per annum would be the equivalent of about 1350 tons of cement.

ROTARY KILNS.

Rotary kilns are usually about 10ft. in diameter by 250ft. in length, but are sometimes constructed as long as 400ft. They are made of steel plates from ⅜in. to 1in. in thickness with one to two sheets to make up the circumference according to the diameter. The joints are usually of the butt type, with external butt straps slightly thicker than the shell. The longitudinal joints are staggered to give uniform strength. A kiln is supported at two or more points on tires. These tires have not only to support the kiln while in motion, but they must also allow for its longitudinal movement due to expansion. The tires are not rigidly fixed to the shell but are fitted on shoes so that they are free to move around the perimeter of the shell. The shoes, which are somewhat similar to rail chairs, are riveted to the shell. To allow for longitudinal expansion each tire runs on two large flat-faced rollers, the bearings being water-cooled. Thrust rollers are employed to keep the kiln in its proper longitudinal position.

The driving girth-gear takes the form of a spur-gear, generally in two parts which are mounted on tangential spring plates riveted to the shell. As the speed of the kiln is between the limits of ½ to 2 revolutions per minute, suitable reduction gear is necessary. The upper end of the kiln extends into the "dust chamber," and arrangements have to be made to render the joint between the kiln shell and the dust chamber wall as air-tight as possible.

The kiln is lined with refractory bricks for about three-quarters of its length from the firing end. Thence to the feed end there is usually inserted a system of curved plates which are designed to cascade the slurry so as to present a greater surface to the gases passing through the kiln. The thickness of the lining generally decreases the further it is from the firing end.

In kiln operation the closest attention should be paid to the following points:—

(1) Keeping the temperature of the flue gases as low as possible.
(2) Reducing the water in the slurry to the minimum possible.
(3) Reducing the amount of excess air.
(4) Providing the most efficient cooler.
(5) Reducing the heat lost by radiation from the kiln.
(6) Maintaining the best possible running hours.

The perfect kiln on the wet process would need to comply with the following conditions:—

(*a*) That the kiln and cooler were perfect heat insulators.
(*b*) That the clinker going out of the cooler was at the same temperature as the slurry going in.
(*c*) That the hot gases passing out of the kiln were no warmer than was absolutely necessary to keep the water in the slurry in the form of steam at 212 deg. Fah.
(*d*) That the air used for combustion and necessarily raised to 212 deg. Fah., which would be the back-end temperature of the kiln, was neither more nor less than was required for the perfect combustion of the fuel in the kiln.
(*e*) That the amount of water in the slurry was as low as possible.
(*f*) That there were no solids carried out with the flue gases.

Heat Lost by Radiation.—The losses from the kiln shell have within recent years received much attention, as it is recognised that a considerable amount of heat is dissipated in radiation and convection. Meade gives the results of an investigation on an 8ft. diameter by 125ft. rotary kiln burning wet materials which was divided into three zones, each 25ft. long, at the feed end, followed by four zones, each 12½ft. long, at the firing end. The total heat lost per hour was 3,603,640 B.Th.U.'s, while the output of clinker during the test was about 3·75 tons per hour. The heat lost per ton was therefore 1,010 000 B.Th.U.'s. The calorific value of the coal was 14,000 B.Th.U.'s per pound, and the consumption per ton of clinker was 707 lb. The total quantity of heat supplied by the coal per ton of clinker was 9,900,000, so that the loss by radiation in this case amounted to 10·59 per cent. of the heat supplied by the fuel. The percentage loss varies with the conditions; thus it has been found that the radiation loss from a horizontal surface exposed to wind is 30 per cent. greater, and of one exposed to wind and rain 70 per cent. greater, than when the surface is exposed only to still air.

Loss in Fuel Gases.—Another large loss of heat occurs in the flue gases. This is in the neighbourhood of 42 per cent. of the heat of the coal burned. Arnold states that approximately 45 per cent. of the total heat in the coal, as fired in insulated kilns, is delivered to waste-heat boilers by the flue gases.

In some other countries waste-heat boiler installations are used to recover part of this heat and to turn it into useful work, but in this country it is not the practice.

Kiln Feed.—It is in connection with the reduction of heat losses in the flue gases that the "atomising" method of feeding the slurry into the kiln is of particular interest. Instead of pouring the slurry into the kiln through a pipe placed nearly vertically, it is forced under pressure through spraying nozzles into the feed end of the kiln. There are generally two or three nozzles, which are capable of being set at different angles and the slurry pressure can also be altered, so that the maximum amount of dispersion is obtained and the greatest surface area is exposed to the flue gases passing through the sprays.

During the passage of the raw materials through the kiln various changes take place, which may be divided roughly into five zones, starting at the feed end.

First Zone.—In this zone, in the wet process, the slurry enters the kiln at about 12 deg. Cent. (53·6 deg. Fah.), the water is evaporated, and the material is raised in temperature. In the dry process only the dry materials have to be raised in temperature. In this zone various secondary reactions occur, such as the liberation of the combined water in the raw materials, and the burning of the sulphur and organic matter.

Second Zone.—In this zone, the dried raw materials are heated to a temperature at which the calcium carbonates commence to decompose. This occurs in a comparatively short distance, as the temperature rises very rapidly. This zone is termed the "heating" zone.

Third Zone.—This zone is called the "calcining" zone, where the CO_2 is gradually given off, the process being complete when the temperature reaches 1100 deg. Cent. The giving up of CO_2 results in a marked reduction of the weight of the material.

Fourth Zone.—In this zone, named the "sintering" or "clinkering" zone, the lime, alumina and silica unite at between 1100 deg. Cent. and 1500 deg. Cent. to produce the mixture of calcium silicates and aluminates which comprises Portland cement clinker. An exothermic reaction takes place adding to the heat in the kiln.

Fifth Zone.—This zone is termed the "firing" zone where the temperature declines as it meets the warmed air necessary for combustion coming from the cooler or other source.

Fuel Supply to Kilns: Pulverised Coal.—The coal, before it is in a suitable condition for burning in a kiln, has to go through a series of treatments. As received, it will have a moisture content of from 8 to 15 per cent.; it will be in sizes from fine dust to lumps of 2in. or more, and it will sometimes be mixed with pieces of metal in the form of iron spikes, &c. It must be prepared so that, at its entry into the kiln, it will be in such a state of fineness that the residue on a 100 by 100 standard screen (10,000 meshes per square inch) after 15 minutes' continuous shaking, will not exceed 5 per cent., and on a 180 by 180 standard screen (32,400 meshes per square inch) will not exceed 15 per cent.

The older method of carrying out this series of treatments was to do them separately; the coal was crushed, and dried metallic substances were separated, it was pulverised, stored and blown into the kiln, each by a separate unit. This method necessitated a considerable amount of plant, capital outlay and heavy running costs. In the later method, all of the treatments are performed by a coal pulveriser generally preceded by a coal drier. The pulveriser is placed directly behind the kiln to be served and is on a level with the firing platform. It is usually placed on its own separate foundation, so that any vibration will not be communicated to the platform. The unit machine, therefore, receives the coal, separates all metallic or other heavier-than-coal substances, pulverises it, and finally delivers it direct into the kiln. Hot air from the clinker cooler at a temperature of about 400 deg. Fah.

* The Institution of Mechanical Engineers. Abridged.

† "Portland Cement," by R. K. Meade, U.S.A. 1926.

is drawn into the machine and comes into contact with the coal during pulverisation, and as a result raises its temperature. A rejector is also arranged so that all particles above a certain size are returned to the machine for further treatment. The power required is about 14 to 15 kilowatt-hours per ton of coal pulverised.

Clinker Coolers.—The size of the usual type of rotary cooler depends on its complementory unit, the kiln, and ranges from 5ft. diameter by 50ft. long to 8ft. diameter by 80ft. long, the horse-power necessary being about 10 to 15 respectively. There are two alternative positions for the cooler with respect to the kiln; either the cooler is set on a continuation of the same axis as the kiln, or it is doubled back underneath it. In either case the hot clinker at about 1148 deg. Cent. (2100 deg. Fah.) falls by gravity into the cooler through the movable kiln-hood; it is cascaded inside the cooler and delivered to the clinker conveyor. Each kiln is provided with a cooler so that the whole represents one unit.

The cooler is lined in various ways partly with firebrick and partly with lifting plates, depending on individual design. At the delivery end it is sometimes perforated for the last three or four feet to act as a rotary screen, the lumps unable to pass through the 1¼in. to 2in. holes being discharged over the end to a separate heap. Alternatively, the discharge end of the cooler has lifting plates so that the clinker is discharged at or near the top of the discharge end, thereby saving 4ft. or 5ft. of height.

One type of cooler recently introduced in this country is a distinct departure from ordinary practice. It takes the form of a combined kiln and cooler. The kiln follows the usual practice, having at the firing end a portion which is of considerably larger diameter than the kiln tube, and it is in this that the clinker is cooled. The cooler comprises a series of tubes arranged around a central cylinder which is an extension of the kiln tube. It is provided with a thin lining of refractory heat-insulating material, and is closed at the end remote from the kiln with a cap or hood of similar design to the firing hoods of ordinary rotary kilns. Kiln and cooler, being rigidly connected, revolve together as a single unit.

Automatic Weighing Machine for Clinker.—It is usual to provide a weighing machine for the clinker as it emerges from the cooler. This machine has to be capable of continuously weighing clinker at a temperature of 110 deg. Cent. and at any rate at which it offers itself. It must also record the weight passed through.

Grinding and Storage Plant.

The degree of fineness to which cement, to conform to the British Standard Specification, has to be ground is such that on a 180 by 180 standard screen (32,400 meshes per square inch or 5022 meshes per square cm.) after 15 minutes' continuous sifting the residue shall not exceed 10 per cent., and also that on a 76 by 76 screen (5776 meshes per square inch or 895 meshes per square cm.) after 15 minutes' sifting the residue shall not exceed 1 per cent. In practice it is usual to grind the clinker to a greater degree of fineness than that which meets the requirements of the British Standard Specification, as, within limits, the finer the grinding the stronger will be concrete in tension and compression. A fineness of 5 per cent. on the 180 by 180 sieve and no residue on a 76 by 76 sieve is common, and for special specifications this can be reduced to 2 per cent. or less on a 180 by 180 sieve.

The finer the cement the more is the power required to grind it; as a rough rule, the power required is directly proportional to the fineness, that is, it takes approximately twice the power to grind to 2½ per cent. as to 5 per cent. fineness. When a fineness of 2½ per cent. is required in a combination mill, the rate of feed would be reduced to about half the rate at which the mill is fed when a 5 per cent. fineness is required.

The types of mills used for grinding clinker are similar to those used for grinding the hard raw materials. The usual type is the combination mill, which has already been described.

Cement Storage.—Adequate arrangements must be made properly to protect the finished cement from the effects of moisture in any form, at all times. The cement may possibly be in the storage silos for months, and any small degree of moisture allowed to come into contact with it would be deleterious. Moisture may be carried in by draughts of air, and protection against these must be provided.

Silos are made of ferro-concrete, or of steel, and although the latter may be slightly cheaper in capital cost, and more quickly erected, they need more attention than silos constructed of ferro-concrete and require periodical painting. The total capacity for cement storage usually provided is about six weeks' output. The number of individual silos making this total may be, in the case of a mill producing 150,000 tons per annum, six or eight of capacities from 250 tons to 4000 tons each.

Packing.—There are two systems by which the cement is packed, the mechanical and the pneumatic systems. One type of mechanical packer or bag-filling machine requires a cement bag with what is called a "valve." This valve is at one bottom corner of the bag, and is made by doubling in and sewing a small portion of the bag. Into this valve is inserted the discharging tube of the packer, and when the bag is filled and the tube withdrawn the weight of the cement in the bag effectively closes the valve.

In one type of pneumatic machine advantage is taken of the fact that in fine powder form cement can be conveyed along a pipe without admixture of extra air, by creating a vacuum at one end of the pipe. The material is extracted direct from the silo simply by connecting a pipe from it to the machine, in which a vacuum is created. The sack or cask is clamped inside the machine, an airtight door is closed, and the air pressure reduced. When the sack or cask is filled and weighs a predetermined amount the supply of cement is automatically cut off, the door springs open and all traces of dust are removed by a fan so that none escapes to the surrounding atmosphere.

Electrical Equipment of a Cement Mill.

Owing to the scattered nature of the units requiring power in a cement works, it is the universal practice to employ electricity for the distribution of the energy. With electricity economies over any other form of power are possible, owing to its ease of transmission to distant points which permits of a central station supply either on the works or from an external source of supply. It also has the advantage that the power taken by each motor can be accurately measured and any irregularities are readily indicated.

Power.—The amount of power required per ton of cement produced depends on the following main factors:—

(1) The hardness of the raw materials.
(2) The position of the quarries.
(3) The process which is employed.
(4) The fineness to which the cement is ground.
(5) The design of the works.
(6) The load factor.
(7) The overall efficiency of the works.

The electrical energy required is between 65 and 100 kilowatt-hours per ton of cement; therefore a factory producing 100,000 tons of cement per annum would require from 6·5 to 10 million units per annum.

Distribution of Power.—If the raw materials are hard the power absorbed in their grinding may take as much as 35 per cent. of the total power required by the whole plant. The clinker grinding mills may take another 45 per cent., leaving only 20 per cent. for all other units. The following list will roughly indicate where the power is absorbed in a mill using hard raw materials:—

Department.	Per cent.
Crushing	6
Grinding	33
Kilns	5
Coal mill	10
Clinker mills	41
Miscellaneous	5
	100

In a mill using soft chalk and clay, the power required per ton may be 20 per cent. less than in a mill using hard raw materials.

Petrol Rail Cars for India.

We have in the past referred to the peculiar conditions of traffic on the Kalka-Simla Railway in India, especially in our issue of November 29th, 1918, in which we gave some idea of the arduous conditions which have to be met there. On a subsequent occasion—see The Engineer of July 8th, 1921—we gave some description of a new type of petrol-driven coach which had been built by the Drewry Car Company, Ltd., of 13, South-place, London, E.C. 2, for the same service. The latest additions to the rolling stock of the railway are by the same makers, and one of the vehicles is illustrated by the accompanying engraving.

The conditions of service on this line, it will be remembered, are severe, as on a line of 60 miles length, with a gauge of 2ft. 6in., there are no less than 24 miles of continuous climbing with only short level stretches in the stations. The ruling gradient is 4·5 per cent., allowing for compensation on account of curvature, and there are curves of 110ft. radius on the running line, while they are as short as 90ft. radius on the turn-outs. Incidentally, the road rises to a maximum altitude of 6880ft. above sea level, has numerous tunnels, and is in the direct track of the monsoons. It was, nevertheless, decided that the new cars should have an average speed of 20 miles per hour when going up the gradient. As a consequence, it has been found necessary to equip them with engines of no less than 85 horse-power for a vehicle carrying fourteen passengers and the driver.

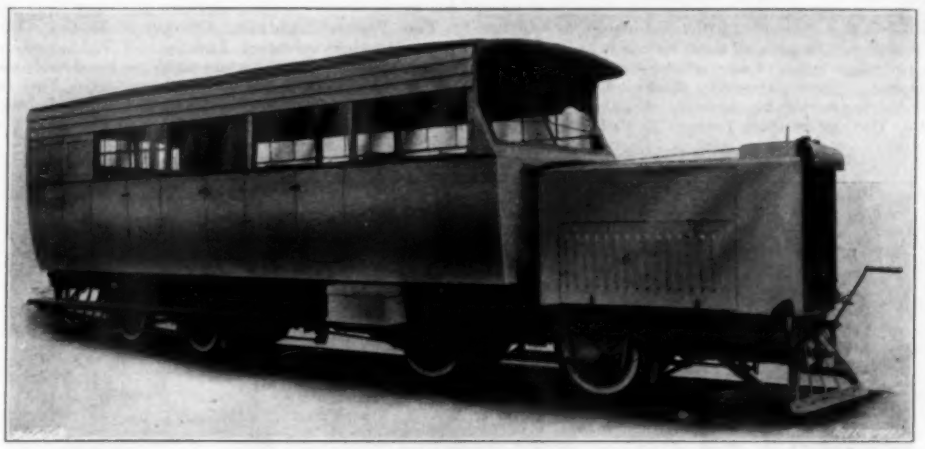
These new coaches are different from those previously supplied by the same company for this service in that they are single-ended. That is to say, they are driven normally only from one end, and are turned round at the end of the journey instead of being merely reversed, and the result is that they have rather the appearance of a large motor omnibus, as will be gathered from an inspection of our engraving. The whole vehicle is carried on two bogies, of which the rear one is devoted only to carrying a share of the weight of the coach. The forward bogie bears the engine unit and provides the driving wheels, so that the only connections between the passenger compartment and the engine are those necessary for the driver's control.

The engine is of the maker's standard type, and has six cylinders, 5¼in. in diameter by 6in. stroke. It runs at 1000 revolutions per minute, at which speed it will develop 85 horse-power. From it the power is transmitted through a cone clutch to the gear-box, which provides speeds of 5, 10 and 20 miles per hour, then to a reversing box, so that all three speeds are available in either direction, and finally by silent chains to the driving axles. The changes of speed are effected by sliding the gear wheels by means of a lever working in a quadrant.

Besides three coaches of the type described above, the same company has supplied the railway with a new four-wheeled vehicle, fitted with a 40 H.P. engine and arranged to carry eight passengers. All the work has been carried out to the specification and under the supervision of Messrs. Rendel, Palmer and Tritton, of Westminster.

PETROL RAIL CAR FOR THE KALKA-SIMLA RAILWAY

THE DREWRY CAR CO., LTD., LONDON, ENGINEERS



The Institution of Civil Engineers.

OCTOBER EXAMINATIONS, 1927.

PASS LIST (*INTERIM*).

(*Subject to confirmation by the Council.*)

The results of the Examinations abroad will be announced later.

Preliminary (46).—J. Banning, W. Bowden, F. E. Bowring, T. H. Carden, E. B. Clark, H. M. Collins, W. H. B. Cotton, W. A. Cross, R. P. Davis, A. H. Eydmann, G. F. FitzHerbert, J. R. Freer-Hewish, K. W. Gent, N. W. Hampson, E. L. Harding, R. E. Hetherington, H. W. Hinitt, C. Hodgson, B. Holroyde, W. R. C. Inkpen, A. McIvor, F. Margerison, G. A. Mather, R. Needham, J. L. L. North, C. J. Oliver, F. Pettinger, B. T. Rees, J. A. S. Rolfe, F. D. Scott, W. B. Shannon, G. B. C. Smyth, N. A. Spencer, V. E. Stanbridge, T. H. Stayman, G. F. Steadman, J. B. Storey, R. W. Tate, J. Tomlinson, E. A. Turner, R. E. Tweedale, H. G. J. Watson, O. F. Westgate, W. L. Whately, D. J. MacG. Williamson, S. C. Wilson.

Associate Membership (190).—*Whole Examination* (*Sections A, B, and C*) (5).—J. W. Allison, W. G. A. Clark, A. E. Crisp, T. C. Ketchen, H. A. Robinson.

Sections A and B only (12).—G. R. Carle, S. M. Davies, R. Inglis, P. M. C. Lindesay, J. H. Lovett, R. A. Mirams, J. S. Robertson, C. P. Shelbourne, F. Unwin, T. D. Watson, S. R. Williams, R. Wyllie.

Sections B and C only (6).—R. G. Booth, J. Campbell, W. C. Clarke, R. V. T. Hoskings, K. Seymour, H. Snape.

Section A only (32).—G. J. le B. Beaumont, A. Begleman, J. B. R. Brooke, F. H. Clark, H. F. Commerford, T. Cooper, B. W. Davies, H. Duckworth, A. C. Dunthorne, J. H. Goodridge, G. G. Gwilliam, C. H. Hales, F. B. Hollis, J. D. How, B. E. Ireland, J. H. Langdon, A. C. L. Law, D. E. Morse, J. H. Murray, L. W. Roberts, W. J. Smith, C. W. Spencer, G. L. Stratton, E. E. Sweeting, C. M. Teulon, W. E. Thorowgood, G. M. Vibart, G. E. Walker, L. E. Williams, F. T. Wood, R. F. Wycherley, J. H. Young.

Section B only (20).—W. G. M. Anderson, N. B. Bennett, C. H. Bradbury, W. H. Burren, L. Carnie, W. A. Clarkson, E. J. Davies, I. N. Deakin, J. McP. Gordon, D. Hide, W. M. Law, J. Mackie, F. S. Snow, E. R. Stables, M. W. Summers, B. W. Sutherns, F. W. Taylor, S. L. Vincent, R. J. Williams, W. O. Wright.

Section C only (115).—A. Adlington, R. P. Alexander, B.Sc. (Belfast), P. M. Anderson, B.A. (Cantab.), R. H. Austin, D. C. Bailey, B.Eng. (Sheffield), R. C. Bestow, B.Sc. Eng. (Lond.), R. T. Betts, B.Sc. Eng. (Lond.), J. Bickley, B.Sc. (Birmingham), J. Blackburn, F. S. Bloomfield, B.A. (Cantab.), N. S. Boulton, B.Sc. (Birmingham), J. H. Brooks, B.Eng. (Liverpool), C. V. Brown, C. W. E. Brown, D. D. Buchanan, B.Sc. (Edin.), J. N. McK. Campbell, B.Sc. Eng. (Lond.), R. D. Carr, B.Sc. (St. Andrews), F. H. Coleby, K. H. B. Collier, R. N. Cove, B.Sc. (Bristol), A. Cowie, E. R. Davies, E. L. Diamond, B.Sc. Eng. (Lond.), J. P. Y. Dickey, B.Sc. (Manchester), F. Dickinson, W. G. Donaldson, R. G. Edkins, B.A. (Cantab.), W. H. Elgar, B.Eng. (Sheffield), E. V. T. Ellis, B.A. (Cantab.), T. E. Emmett, H. H. Facey, A. J. Gardiner, G. A. M. Gentry, R. Grah, B.Eng. (Sheffield), A. H. Greenham, B.A. (Cantab.), J. R. B. Griggs, B.Sc. Eng. (Lond.), A. A. Gross, B.Sc. (Birmingham), W. E. de C. Hamilton, B.A. (Cantab.), J. H. Hanning, B.Sc. (Edin.), R. A. Harrison, H. S. Heath, R. B. Heseltine, E. Hoyte, P. G. Hudson, B.Sc. Eng. (Lond.), W. B. Instone, J. Jagger, B.Sc. (Leeds), N. V. Jeffery, R. W. Jenkins, B.A.I. (Dubl.), H. S. Keep, B.Sc. Eng. (Lond.), E. L. Kelting, E. J. R. Kennerell, B.Sc. Eng. (Lond.), G. F. Kent, J. McE. King, A. C. Korner, T. T. Lambe, B.Sc. Eng. (Lond.), S. A. Lambert, C. F. Lapworth, B.Sc. Eng. (Lond.), J. W. B. Leng, B.Sc. (Durham), H. R. Lillie, B.Sc. (St. Andrews), C. F. J. Lisle, B.Sc. (Birmingham), J. W. Lowdon, B.Sc. Eng. (Lond.), J. Lowe, B.Eng. (Liverpool), J. B. Lund, R. H. MacDonald, B.A. (Cantab.), A. S. Maclaren, B.A. (Cantab.), H. E. Manning, B.Sc. Eng. (Lond.), D. B. Martin, B.Sc. Eng. (Lond.), O. J. Masterman, B.E. (Tasmania), D. G. Mead, T. R. T. Middleton, B.Sc. Eng. (Lond.), J. D. Midforth, H. Milne, A. Mitchell, F. C. T. Nutter, A. A. Paul, B.Sc. (Glas.), P. U. Proudfoot, B.Sc. (Edin.), J. Reed, B.Sc. (Edin.), A. K. Richards, W. M. L. Roberts, B.Eng. (Liverpool), R. G. Robertson, B.A. (Oxon.), W. A. R. Robertson, L. G. B. Rock, B.Sc. Eng. (Lond.), W. T. Rondel, W. S. Rope, B.A. (Cantab.), E. L. Rushbrook, J. E. Scrase, B.Sc. Eng. (Lond.), J. Shaw, J. H. Shennan, B.A. (Cantab.), J. W. Simpson, B.Eng. (Liverpool), D. G. Skitt, G. Smellie, R. W. C. Smith, R. W. Stanton, B.Sc. Eng. (Lond.), K. F. Starling, B.A. (Cantab.), W. Strother, J. N. Taylor, B.Sc. (Manchester), A. K. Terris, B.Sc. (Edin.), H. A. Thomas, B.Sc. (Wales), P. W. Thomas, B.Sc. Eng. (Lond.), J. H. H. Thompson, B.Sc. (St. Andrews), M. Thompson, B.Sc. (Durham), J. K. Thorpe, B.A. (Cantab.), H. K. Tuck, B.A. (Cantab.), F. Tunnell, B.Sc. Eng. (Lond.), L. R. Waddington, B.A. (Cantab.), M. J. Wardle, G. W. Warr, jun., W. R. Watson, B.Sc. Eng. (Lond.), H. Whipp, B.Sc. (Manchester), H. N. Wilford, C. W. M. Williams, B.Sc. (Wales), G. Wilson, B.Sc. Eng. (Lond.), K. F. W. Woods, F. L. Wooldridge, F. L. D. Wooltorton, B.Sc. Eng. (Lond.).

The Public Works, Roads and Transport Exhibition.

No. III.* (*conclusion*).

MESSRS. Ruston and Hornsby, Ltd., of Lincoln, in addition to showing examples of their airless injection, crude oil, and other types of oil engines, pumps, &c., had on view one of their patented "Thermax" boilers constructed for a working pressure of 120 lb. per square inch. The outstanding feature of their stand, however, was one of their No. 4 excavators arranged for a petrol-paraffin drive. This useful machine can be adapted for use as (*a*) a crane navvy, (*b*) a dragline, (*c*) a grabbing crane, (*d*) a skimmer scoop, (*e*) a trenching machine, and (*f*) an ordinary locomotive crane. It is of the full circle type and its bucket has a capacity of ½ cubic yard. It is designed for excavating clay of medium hardness and easier materials. Our engravings Figs. 17 and 19 illustrate the machine first arranged as a skimmer scoop removing the surface from a London roadway, and secondly as a back trencher working on a Liverpool housing scheme. It is a one-man machine rendered self-contained by its internal combustion engine and independent of rails or prepared roads by its caterpillar tracks. Its approximate weight is 14 tons, while the length of its jib is 16ft. 9in., and the brake horse-power of its engine 35. It will walk on to a low railway wagon, pass the loading gauge, and walk off at the end of its journey direct on to its job. It will, moreover, go through a 7ft. 6in. gateway.

FIG. 17—NO. 4 EXCAVATOR ARRANGED AS A SKIMMER SCOOP—RUSTON AND HORNSBY

The Bromford Tube Company, Ltd., of Birmingham, was showing weldless steel tubes of numerous sizes from ⅜in. to 10in. in bore, straight, bent, flanged and manipulated in various ways. They are intended for gas and water mains, sewage piping, telephone ducts, tram and transmission poles, lamp standards, &c. &c.

The Patent Lightning Crusher Company, Ltd., 14A, Rosebery-avenue, London, E.C. 1, had, as usual, examples of its stone-crushing machines, and, in addition, hammers, screen bars, &c. The two crushers were its Nos. 1 and 2 crushers and granulators, the first having a capacity up to 6 tons per hour when dealing with material of 2½in. to 3in. cube feed size and reducing it to 1in. cube and downwards, and the other with a capacity up to 15 tons per hour when fed with 3in. to 5in. cube feed size and taking it down to ¾in. cube and under.

Metal Traders Technical, Ltd., of 7, Gracechurch-street, London, E.C. 3, had in operation outside the Hall a machine for making what is termed "Deaerated Concrete." The machine is illustrated in Fig. 18, and was another of the novelties of the Exhibition.

Deaerated concrete, it may be explained, is a form of concrete made on a system which is patented and in which the mixing is done in vacuum. The process is said to be a practical method of ensuring that the whole of the conditions obtainable by the use of modern cements in the laboratory can be reproduced in bulk under actual working conditions. It is claimed, in fact, to do automatically and thoroughly what the laboratory gauger and the conscientious workman endeavours to do—that is, to consolidate the concrete. The mixer exhibited has a hopper capacity of 10½ cubic feet, giving 7 cubic feet of mixed concrete per batch. It is of the rotating drum type, the drum and its load being carried on ball-bearing plummer blocks. The whole of the moving parts of the machine—drum, gearing, engine and air pump—are carried on a sub-frame built up of stayed channel sections, which is supported in the outer form by means of a three-point suspension, to protect the drive from stresses which may be set up by distortion if the machine be used on an unlevel foundation. The whole of the gearing on the mixer is machine cut and no chain drives are employed. A Dorman four-cylinder engine was fitted to the model shown, and the air pump—the patented feature in this machine—is direct driven through a flexible coupling. The air pump is of the rotary type, and a vacuum of 28in. can, it is stated, be readily obtained in the drum. The engine, with its controls, and the air pump are enclosed in a bonnet.

FIG. 19—NO. 4 EXCAVATOR DIGGING TRENCH

A number of claims are made for deaerated concrete. In the first place, the introducers point out that microscopic examination reveals the fact that ordinary concrete is full of minute air pockets which render it both weaker and more porous than it would otherwise be. The extent of these air pockets is, they continue, remarkable. In a 4 : 2 : 1 mixture of shingle sand and cement the weight of the concrete, which was originally 140 lb. per cubic foot, was increased to 148 lb. per cubic foot by deaeration. Then, again, it is claimed that deaeration practically doubles the compressive strength of the concrete, and, further, that it makes it waterproof. In support of the latter statement we may say that we have been shown the results of two tests made by Mr. R. H. Stanger, Assoc. M. Inst. C.E., of Westminster, with 4 : 2 : 1 mixture, in the one case ordinary and the other deaerated. In both cases the area under pressure was the same—20in.—the thickness the same

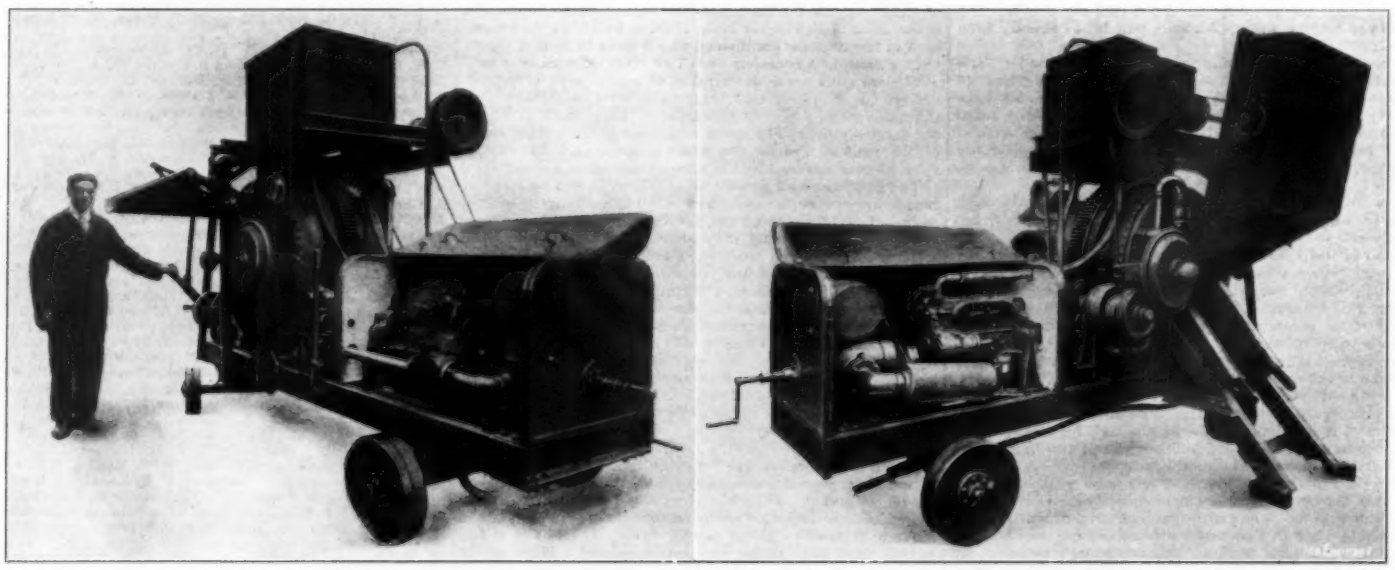


FIG. 18—MACHINE FOR MAKING "DEAERATED CONCRETE"—METAL TRADERS TECHNICAL, LTD.

* No. II. appeared November 25th.

—4in.—the age the same—twenty-eight days—and the pressure the same—60 lb. Yet, whereas with the normally made concrete the percolation in six hours was 1·0 c.c., the percolation with the deaerated concrete in the same time was only 0·1 c.c. Furthermore, in an abrasion test with twenty-eight-day concrete made with shingle and sand, with an area of 30 square inch and a weight of 29·75 lb., the loss in one hour was 0·19 lb. with normal concrete, but only 0·06 lb. with deaerated concrete. We are also informed that tests have been made which show clearly that handling—even violent handling—after mixing will not reaerate the mixture to any great extent.

It is well known, of course, that strengths of concrete made in the field may fall far short of those found in the laboratory, and the behaviour of deaerated concrete in actual practice will be looked forward to with interest.

FIG. 20—CONCRETE MIXER—RANSOMES AND RAPIER

The Paterson Engineering Company, Ltd., of Windsor House, Kingsway, W.C. 2, had a number of interesting exhibits, including its latest type of Chloronome, specially designed for use in connection with the purification of swimming bath water. There were also scale models of the standard Pulser type Chloronome, which is intended for the sterilisation of water supplies up to, say, 2,000,000 gallons a day, and the Manometer Chloronome, which is used for supplies in excess of that quantity. Another model was that of four 8ft. diameter Paterson pressure filters. This model was based on two installations, each of four such filters, which have been in successful operation for the past few years at Malvern, each battery dealing with 500,000 gallons of water per day.

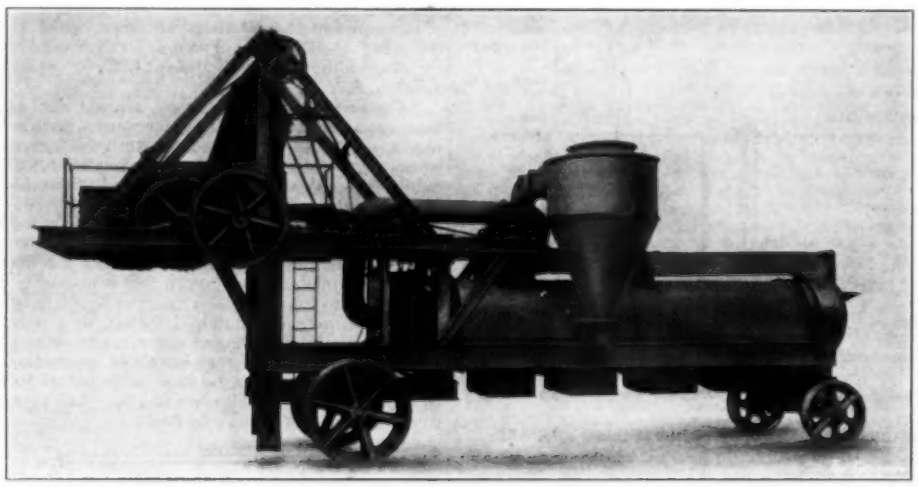


FIG. 21—"JACTA" BITUMINOUS MACADAM PLANT—GOODWIN, BARSBY

The type of rapid gravity filter adopted by the Metropolitan Water Board and other authorities, for the prefiltration of water supplies before passing on to slow sand beds, was indicated by a model of the installation of 9,000,000 gallons daily capacity at the Barn Elms works of the Board. In connection with the softening of hard waters, the company also displayed a model of its by-pass type chemical proportioning gear.

Ransomes and Rapier, Ltd., of Ipswich, in addition to two tilting drum concrete mixers—one the "Lightweight" of 5 cubic feet mixed batch capacity—a view of one of which is given in Fig. 20—the other the "Featherweight" of 3 cubic feet capacity—were showing three of the component parts of the Ransomes-Rapier-Marion excavators. They were:—(1) A completely enclosed splash-lubricated engine, such as is used for the "crowd" and rotate machinery of the small excavators from 1 to 2 cubic yard capacities; (2) a complete crawler frame unit for 1 cubic yard type 7 excavator; and (3) the main underframe casting and rotate gear ring for a type 7, 1 cubic yard excavator.

The makers explain that the splash lubrication of the engine is a feature introduced by Marion for the first time on standard excavators, and claim that it will undoubtedly revolutionise maintenance methods of excavating machinery. The engine exhibited is entirely enclosed in an iron casting, which has machined oil-tight joints, in order to prevent stones, abrasive dirt or grit getting into the engine, and causing breakdowns, and to reduce replacements of bearings and wearing parts to a minimum. They further point out that as the whole engine runs in oil very little attention to lubrication and adjustment is required.

The crawler design will be considered somewhat unusual by the people in this country who are not familiar with the Marion design. The main special alloy cast steel beam gives very great lateral strength. The crawler pads are of special heat-treated steel, designed to provide a smooth surface to prevent grit getting in between them. The crawler is driven by self-cleaning spur gear and the crawler belt itself is self-cleaning.

Metropolitan Gas Meters, Ltd., of Nottingham, was giving demonstrations of clockwork controllers for street gas lighting, and showed models of the mechanism employed.

The Horstmann Gear Company, Ltd., also exhibited examples of Newbridge automatic gas controllers and electric time switches for public street lamps. In both cases there were ranges of apparatus for lights of different intensities. The company also showed its checking controllers and time switches for automatically reducing the intensities of lights after a given time in the night.

A small model of their filtration plant was exhibited by Bell Brothers (Manchester, 1927), Ltd., of Denton, near Manchester.

On the stand of Shelvoke and Drewry, Ltd., of Letchworth, was, among other vehicles, one of their standard Freighter dust carts. In it the makers claim to have developed a vehicle which, while it possesses the hygienic features of the German vehicles, retains all the advantages of their standard Freighter dust cart, viz., the low first cost, special manœuvring power, low loading level, foolproof control, mechanical tipping gear and low maintenance and collection costs.

FIG. 22—6-TON STEAM WAGON WITH ASPHALT MIXING CAULDRON—FODENS

The roof of the body has a series of openings on each side, which are covered by light metal shutters, and each of which is connected to a foot bar a few inches above the pavement level, so that it can be operated by a slight pressure of the foot. The loader, it is stated, almost instinctively places his foot upon the foot bar as he lifts the bin, the shutters opening only while the bin is being discharged and closing instantly as the man removes his foot. As the closing of the shutters is automatic—unlike the usual loose covers which are often left open—and does not call for the attention of the loaders, it is impossible for the vehicle to stand or to move from place to place with its contents exposed to view, and also liable to be scattered by the wind. The operation of the shutters does not depend upon the form of bin or other receptacle used, and the vehicle can be employed to discharge equally at a destructor or upon a tip. The motion imparted to the shutters by the actuating mechanism is partly sliding and partly lifting, the latter being introduced to avoid the sticking which is inseparable from the ordinary sliding shutter when grit is present.

In all respects, other than the roof and shutters, the dustless loading Freighter is the same as the firm's standard dust cart, and it is equipped with the same hydraulic tipping gear for the easy discharge of the refuse.

Samuel Pegg and Son, of Leicester, showed, in addition to a granulator and a stone breaker, a pan type concrete mixer specially intended for making concrete for paving slabs, hollow building blocks, pipes, reinforced concrete blocks, &c. Its leading feature is its hinged discharging scrapers, which are said to empty the pan completely and efficiently.

The most noticeable exhibit on the stand of Goodwin, Barsby and Co., Ltd., of Leicester, was the "Jacta" bituminous macadam plant which is illustrated in Fig. 21. This machine embodies several improvements as compared with machines of a similar type shown by this firm in past years. It comprises a dryer of the "Pyrus" design, 20ft. long and 3ft. in diameter, which is furnished with balanced draught arrangements, a cyclone dust collector, a measuring and loading skip, and a ½-yard "Good-win" double-shaft paddle mixer. As exhibited, the plant had a feeding elevator of the dredger type to the dryer, a tar measuring tank with tar pump and pipes, and a bitumen bucket with a hoisting arrangement. Other exhibits on this stand were a couple of portable concrete mixers and an "Acme" portable granulator.

John Fowler and Co. (Leeds), Ltd., in addition to exhibiting a road roller, some concrete mixers, and other road plant, showed an example of their new steam gully emptier, which was illustrated and described in the issue of THE ENGINEER for October 21st last. There was also a novelty in the form of a 40 H.P. motor shunting engine, which looked a most serviceable machine. It is claimed for this locomotive that it will handle heavier loads than a standard steam locomotive of the same weight, because of the more

uniform driving torque which reduces the liability of slipping. The drive is through a three-speed gear-box running in oil to a jack shaft and thence by coupling rods to the driving wheels. The reversing gear provides three running speeds in either direction. The builders state that on properly laid tracks this engine will haul 350 tons on a level or 110 tons up a gradient of 1 in 100.

On the stand of Fodens Ltd., of Sandbach, was only one exhibit. It was one of the firm's well-known 6-ton steam wagons having mounted on it an asphalt mixing cauldron, and it is illustrated in Fig. 22. As will be observed, the road wheels are rubber tired. The cauldron is made in two parts, the inner of which is the boiler to contain the asphalt. The latter is mixed by a series of eleven revolving cast steel arms carried on a cast steel shaft which is rotated through worm gearing and belt from the fly-wheel of the engine of the wagon. The melted asphalt is discharged through a spout in the rear, which is arranged immediately over, but well clear of, the boiler fire-box.

Reavell and Co., Ltd., of Ipswich, were, of course, showing a number of their well-known portable air compressors for various purposes, with which our readers are familiar, and also a series of pneumatic picks, spades, &c. There were also two garage pumps for inflating pneumatic tires, one of the electrically driven and one for hand operation. The former, it is said, will pump up an average motor car tire from dead flat to 80 lb. per square inch in 1¼ minutes. It has a maximum working pressure of 150 lb. per square inch. The hand machine, when operated by one man at seventy strokes per minute, can, we are informed, inflate an average motor car tire from dead flat to 80 lb. per square inch in 1¾ minutes. It has a maximum working pressure of 100 lb. per square inch, and is a very neat little machine.

There were two interesting exhibits on the stand of the Chaseside Engineering Company, Ltd., of Enfield. One was what is called a "Hi-Lift" loading shovel and the other a crane. Both are fitted with Fordson tractors to provide the operating power. The loading shovel is designed to move and load such material as tar-macadam and other road materials, such as sand, gravel, brick, stone, lime, &c., at the rate of from 20 to 30 tons per hour. It is described by its makers as being "an ideal tool for bridging the gap between hand labour and the steam navvy." The crane has a capacity of from 15 to 20 cwt. It is particularly intended for working in confined spaces, its tractor having a turning radius of 10ft. The overall height of the crane is 15ft. and the height under the hook is 11ft. 6in., while the clearance to the front of the tractor when the hook is lying on the ground is 5ft.

Weston, Shipley and Weston, Ltd., of Leicester, exhibited, amongst other things, two interesting machines. The first was its "Kut-out" machine for cutting all classes of gas and water mains, and the other a "Driltaparatus" for drilling and tapping pipes under pressure.

Allan Taylor and Co., of 126–128, High-street, Wandsworth, London, S.W. 18, had a display of Ford vehicles adapted to a number of municipal and other uses, including one for golf course purposes, which embodied a tank capable of holding 500 gallons of water.

On the stand of the Manchester Water Meter Company, of Ardwick, Manchester, were examples of different types of water meters.

T. Baker and Sons, of Compton, near Newbury, Berks., showed a horse-drawn road sweeping machine, a 200-gallon cranked axle tumbler cart fitted with renewable brushes, and a hand dust cart on three wheels.

A "multiple batch mixer" was the feature of the stand of Concrete Equipment, Ltd., of 4–6, Star-road, West Kensington, London, W. 14. The machine is fitted with a three-speed gear-box, which gives it capacities of 6, 12, or 18 cubic yards per hour, as desired.

The Hydraulic Engineering Company, Ltd., of Chester, was exhibiting a model of the Mangnall-Irving thrust borer—with the construction and operation of which our readers are familiar—and also a new device which has been brought out for use in connection with the borer to give warning when a metallic obstacle, such as a gas or water main, is met with in course of boring operations. This device, the general arrangement and pilot detector mechanism of which are illustrated in Figs. 23 and 24, embodies a small electric glow lamp, a trembling bell and a battery in its construction. If no metallic obstruction be met with the lamp is only dimly illuminated and the bell is silent, but as soon as metal is touched two insulated portions of the boring head are metallically connected which causes the bell to ring and gives warning that pressure on the boring head must be relieved. We have no space to describe the mechanism in detail, but can only say that it is highly ingenious, and that should any fault occur in it the small glow lamp ceases to be illuminated and that if, for any reason, the alarm bell fails to work, the small lamp gives notice of the fact by becoming brilliantly lit.

Various machines and tools for the breaking up of concrete roads, &c., were to be seen on the stand of the Atlas Diesel Company, Ltd., of 35, Surrey-street, Strand, London, W.C. 2.

Allen-Liversidge, Ltd., of Victoria Station House, Westminster, S.W. 1, had an attractive stand containing oxy-acetylene welding and metal cutting equipment both for high pressure with dissolved acetylene and for low pressure, as well as blow-pipes adapted for various purposes, including brazing, soldering, lead burning, &c. There were also some portable emergency lighting equipments.

The various meters and recording apparatus on the stand of Guest and Chrimes, Ltd., of Rotherham, were most interesting. There were meters for hot and cold water, steam, compressed air, oil, &c., and there was a Venturi tube shown under working conditions in conjunction with a number of indicators and recorders.

Broom and Wade, Ltd., of High Wycombe, exhibited examples of their well-known portable air compressors of various types and sizes, the motive power being either petrol or crude oil engines.

F. G. Barnes, of Godalming, showed a tar-spraying and road brushing machine; Braham, Patterson and Benham, Ltd., of Limehouse, London, E. 14, bitumen boilers and mixers of various types and a portable rotary dryer; and A. A. Byrd and Co., of 11, Queen Victoria-street, London, E.C. 4, their Metaform steel shuttering and a concrete mixer.

Pneumatic tools of various kinds, including hammers, spades, tampers, rock drills, &c., were shown by the Consolidated Pneumatic Tool Company, Ltd., of Egyptian House, 170, Piccadilly, London, W. 1, on a most attractive stand on which we also saw some portable air compressors.

A charming display was that of the Cambridge Instrument Company, Ltd., of 45, Grosvenor-place, London, S.W. 1. It included vibrographs, accelerometers, stress recorders, temperature regulators, draught and pressure gauges, &c.

Another delightful exhibit was that of George Kent, Ltd., of Luton. Years ago one used to think of this firm in connection with knife cleaning machines, now it makes a large proportion of the recording apparatus used in waterworks and for similar purposes, as well as water meters and kindred apparatus. It is always a pleasure to examine the instruments and apparatus made by this firm.

The Perkins Macintosh Petroleum Tool and Boring Company, Ltd., of 25–27, Bishopsgate, London, E.C., had on view two "Permac" compressor tractors of 118 and 160 cubic feet capacity, as well as Gardner compressors, road breakers, &c.

Electrolux Ltd., of 153–5, Regent-street, London, W. 1, showed, in addition to vacuum cleaners, examples of its refrigerator and its water softener.

An excellent display of trucks of various kinds was made by H. C. Slingsby, of 89–97, Kingsway, London, W.C. 2, including his Jacklift master truck.

A large variety of joints for iron and steel tubes and for cement, cement-asbestos and cast iron pipes was exhibited by the Victaulic Company, Ltd., of Millbank, London, S.W. 1.

A wide selection of electrical heating devices, including stoves, water heaters, fires, &c., was on the stand of the Jackson Electric Stove Company, Ltd., of 143, Sloane-street, London, S.W. 1.

Many types of washerless taps for numerous purposes were shown by the London Valve Company, Ltd., of Birmingham.

An effective exhibition of automatic acetylene beacons specially intended for providing flashing light signals at intersections of roads or other places requiring special cautionary or danger warnings was made by the Gas Accumulator Company (United Kingdom), Ltd., of Brentford. Electric flashing road beacons of the pedestal and suspended types were shown by Barber and Colman, Ltd., of Brooklands, Manchester.

A well-made working model of the Barber-Greene Ditcher was to be seen on the stand of R. H. Neal and Co., Ltd., of Ealing, London, W. 5.

Examples of the tubular scaffolding, which is now replacing wooden poles in so many cases, were shown by Scaffolding (Great Britain), Ltd., of Stockwell, London, S.W. 8.

"Chequerboard" and other screens for garden fencing and for river bank reinforcement, such as was used in connection with the river Rother improvement works referred to in our issue of November 11th, were exhibited by T. and C. Associated Industries, Ltd., of 98, Great Russell-street, London, W.C. 1.

At the commencement of our account of the exhibits at this interesting Exhibition we referred to the large number of stands containing materials for making, mending or maintaining roads. As a matter of fact, in addition to those of which mention has already been made, well over one hundred stands, or nearly half of the total number, showed either roadmaking materials, roadmaking or repairing tools, or methods of roadmaking. It would be impossible for us to refer to each and all in detail; we can only say that they were, nearly all of them, excellent.

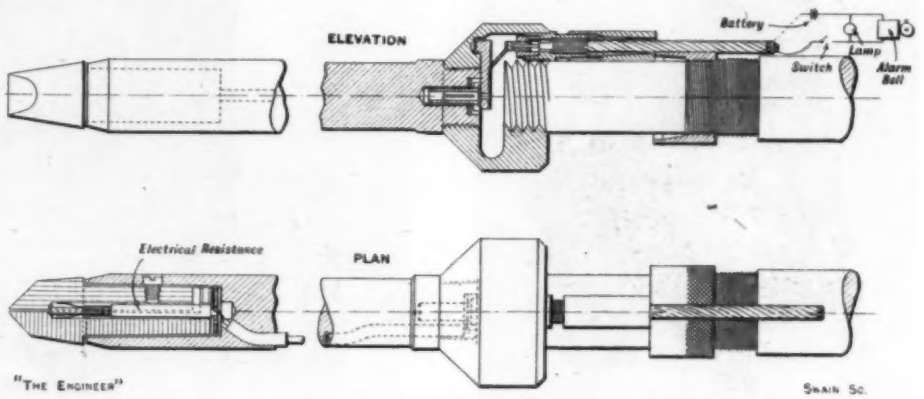


FIG. 24—THRUST BORER, PILOT DETECTOR MECHANISM—HYDRAULIC ENGINEERING COMPANY

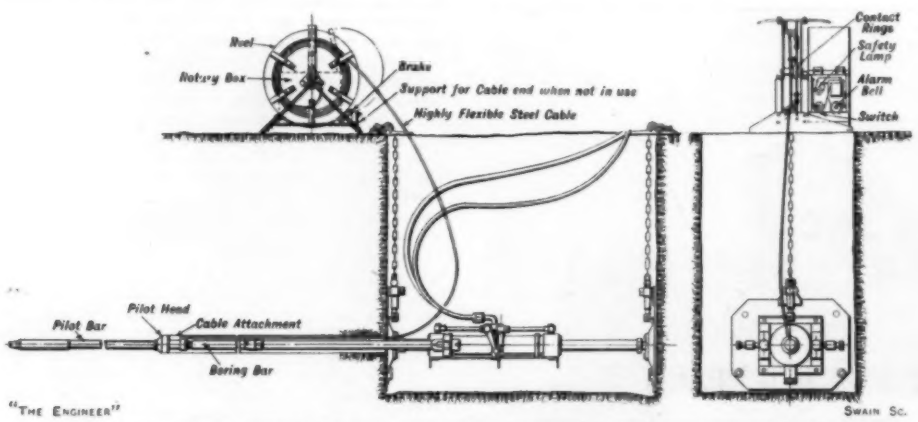


FIG. 23—MANGNALL-IRVING THRUST BORER WITH PILOT DETECTOR—HYDRAULIC ENGINEERING COMPANY

CONTROLLING BEET SUGAR MACHINERY.—A rather unusual development of the two-wire system of railway signalling came under our notice when making a recent visit to the Ely Beet Sugar Factory. A beet sugar factory has to be worked at high pressure during the four months of the "campaign," when the beet is being harvested and its sugar extracted, and, although the remaining eight months of the year may be devoted to the overhauling of the plant, there is the possibility of some mishap or other occurring during the running period. Apart from the risk to the operators which may result from such a mishap, the whole process may be disorganised. It is therefore essential, that, in the case of emergency, the working of the plant may be readily controlled to meet the exigencies of the occasion. At the Ely factory such provision has taken the form of several "frames," made by the Westinghouse Brake and Saxby Signal Company, of 82, York-road, London. These frames are of the standard pattern used by the makers for operating railway signals and points, and comprise, in essentials, a sheave round which there is wrapped the bight of a wire rope. The sheave is mounted in appropriate bearings, and can be rotated by a hand lever. The rope is led around the necessary fairleads, and is attached to the distant mechanism which it is desired to operate. Originally the installation was so arranged that the various levers were interlocked and could only be operated in a definite sequence; but experience has shown that it is preferable to rely upon the wits of the operator in a case of emergency.

Railway Matters.

THE midnight express from St. Pancras to Manchester came into collision in a fog in the early morning of November 22nd with a goods brake van and some wagons near St. Mary's Junction, Derby.

PARLIAMENTARY notice has been given by the Regent's Canal and Dock Company for the acquisition of the Grand Junction Canal, the Warwick and Birmingham Canal, the Birmingham and Warwick Junction Canal, and the Warwick and Napton Canal.

THE harbour at Newhaven passed from the possession of the Newhaven Harbour Commission into that of the Southern Railway Company under powers obtained by the latter in 1926. The last pier was erected some fifty years ago, and is a timber structure 500 yards long. It has now been decided to reconstruct it in ferro-concrete at a cost of about £100,000.

THE London and North-Eastern Railway Company proposes shortly to introduce some 4–4–0 three-cylinder engines for intermediate services, principally in the North-East of England and in Scotland. They will bear names, and the twenty-eight now under construction are to be called after the shires. Those named after the Scottish shires will operate in Scotland.

IN a written reply to a question in the House of Commons by Commander Bellairs with reference to a suggestion that an amalgamation of the Great Western and Southern Railways would lead to better co-ordination, Colonel Wilfrid Ashley said: "I should deprecate any disturbance at present in the general scheme for the grouping of the railways that was settled by Parliament in 1921."

THE management of the Austrian State Railways has decided to stop further electrification of the system as the present low price of coal renders steam traction cheaper than electricity. It is also stated that the railways are now able to use inferior grades of coal, particularly for goods traffic. The cost of electric current is now higher than in the inflation period, while the price of coal is considerably lower. It is understood that the decision of the railways is not absolutely final, but that further electrification is indefinitely postponed.

PLANS have been prepared by the Canadian National Railways—Government-owned system—for the construction of an immense central passenger depôt in the heart of the city of Montreal. An overhead project, subways, and level constructions are involved, and there will also be erected a huge office building, in which will be housed thousands of employees of the railway and allied services now scattered throughout the city of Montreal in half a dozen buildings. The station itself will be underground, as is the case with the Pennsylvania and New York Central depôts in New York City.

IN its Political Notes, in the issue of *The Times* for November 18th, it was stated that the Labour Party had had a meeting to consider the course of action to be taken when the London Traffic Pool Bill comes up for consideration. Our contemporary reports that it was "decided to table a reasoned amendment on the second reading, expressing the official Labour view that the solution of the traffic problem can be effected only by public ownership. But it was further agreed that, when that amendment has been defeated, every assistance shall be given to the promoters of the Bill, and that only constructive criticism shall be offered."

BEYOND the powers to be sought for owning and working road vehicles, mentioned in this column of our issue of November 25th, the railway companies have only two small works for which they propose to ask for parliamentary sanction. One is the application of the Great Western to abandon the north dock at Swansea, part of the Swansea Canal and a portion of the Oystermouth Railway, and to build walls and embankments. The other is the proposal of the London, Midland and Scottish Company to build a curve 1¼ miles long from its Mansfield and Southwell branch at Farnsfield to the Mid-Nottinghamshire Joint Railway, sanctioned last year.

CLAYTON Tunnel, on the main line to Brighton, is 2266 yards long. It was opened, as part of the section between Hayward's Heath and Brighton, on September 21st, 1841, and when constructed a culvert was provided to carry off the water that enters the tunnel from numerous springs. The culvert was laid in the "six-foot," but at its widest part the sides reach to under the "four-foot" of both lines. With the growth of traffic it has been considered necessary to strengthen it and the work is now in hand. As a speed restriction of 15 miles per hour has been imposed, there must necessarily be delays to trains, and the Southern Railway has therefore given public warning accordingly.

THE report by Colonel Sir John Pringle to the Ministry of Transport on the collision of June 27th at Wimbledon was issued on November 21st, having been delayed for three months in order to allow the motormen to recover from the injuries they received. The trains concerned belonged to the Metropolitan District Railway, and were electrically operated. One was an arriving train and the other a departing, and they met practically head-on just outside the station. The former was running with clear signals into No. 3 road, and consequently the signals for the departing train should have been against it. The station belongs to the Southern Railway, whose men work the signals. Both the motorman and guard of the outgoing train said that the starting signal was "off," but the former did not see it after a minute before he was due to start, and the latter testified that he saw it "a minute or so." No one could speak as to the position of the signal when the train passed it, and from various conditions it is safe to conclude that it was "on," and that the motorman of the outgoing train passed it at "danger." Attention is drawn in the report to the fact that, whilst the District Railway has a rule that the hand signal to start must not be given by the conductor if the fixed signal is at "danger," such a rule is not to be found in the Southern Railway instructions. Sir John Pringle also points out that had there been a train stop at the signal, the trip on the train, provided for the train stops on the District Railway, would have engaged and the train been automatically stopped.

Notes and Memoranda.

AN important discovery of the precious variety of beryl has been made in the Transvaal. It is said that it may prove to be one of the largest of its kind in the world.

IN a paper read before the Institution of Automobile Engineers, Captain C. H. Kuhne said that a heavy lorry, with thin solid rubber tires, travelling fast on a country road, might deal blows on its surface with its wheels with as great a force as 35 tons.

AT a recent meeting of the French Academy of Science, Monsieur James Besset read a paper describing an apparatus he has constructed for studying chemical reactions under a pressure of 20,000 atmospheres. The apparatus has been designed primarily for the study of the allotropic modifications of carbon.

THERE has been a steady improvement in the economy of oil burning locomotives in America within recent years. On one line the consumption is 11·94 gallons per 1000 gross ton-miles, or 0·95 gallon per passenger car mile. The corresponding amounts for another line are 10·38 and 0·88 gallons respectively.

FOR the purposes of making a concrete road in Colorado, ore from the dump of a local gold mine was used as aggregate. It was the most suitable material available, although it contains 1·50 dollar's worth of gold per ton, according to the *Bulletin* of Ontario. There is 3000 dollar's worth of the precious metal in every mile of the road.

A YEAR ago refined platinum commanded £23 per ounce, but to-day substantial qualities may be obtained at £13 15s. per ounce and small lots at £14 per ounce. The present low price is attributed by a correspondent of *The Times* to the fact that the Russian output is rapidly increasing. Last year it was 3600 kilos., against 650 kilos. in 1922.

ACCORDING to Mr. W. A. Whatmough, the heating of the intake manifold of a petrol carburetter is relatively ineffective in providing a good mixture in the engine, as it leads to fractionation and the partial evaporation of the fuel, besides being uncontrollable. He recommends the heating of the induction air under the control of a thermostat.

EXPERIMENTS carried out in Toronto have shown that if electric tramway trolley wires are greased occasionally any sleet which may tend to accumulate on them in wintertime adheres so slightly that it is easily knocked off by the passage of the trolley wheel, and arcing is consequently minimised. Greasing also reduces the wear on the wires on curves by about 60 per cent.

ACCORDING to *Water and Water Engineering*, there is an advantage in not having a foot valve on the suction of a centrifugal pump, as if the pump is shut down suddenly, owing to accident, with the discharge valve open and the check valve does not hold, the water hammer on the pump line comes back through the pump, and if the water is held by a foot valve the pump casing will in all probability be damaged seriously. If there is no foot valve, the water hammer is relieved by the water passing directly through the pump back into the suction reservoir or well.

AMERICAN manufacturers are experimenting with the construction of larger, more powerful oil-electric locomotives. One company was building in May, 1927, an experimental 1000 horse-power oil-electric locomotive, using a six-cylinder, four-cycle Diesel engine. A second manufacturer is working on a locomotive with a twelve-cylinder, four-cycle engine rated at 960 horse-power at 325 revolutions per minute. Three other companies are working on locomotives with a six-cylinder, four-cycle engine rated at 750 horse-power at 500 revolutions per minute. One railway company has designed a new type of Diesel locomotive and is building three of them in its own shops.

THE Paris Municipal Council has elaborated a scheme by which the city will be provided with a constant supply of hot water for central heating. A large power station is already in existence on the Quai de la Rapée, which was formerly used to supply power for the underground railway, but is now no longer required, and it is proposed to convert it for the purpose. One station would not be sufficient for the whole of the capital, and it is therefore proposed to put the scheme into practice first of all in the eastern districts. Later a hot water system would be provided for the other quarters of Paris. It is estimated that a municipal system of distributing heat would be less costly than the present price of central heating, even in cases in which one furnace serves a whole block of flats.

IT has been shown by L. P. Curtin and M. T. Bogert, of the research staff of the Western Union Telegraph Company, that chlorination of the hydro-carbon portion of coal-tar creosote reduces its toxicity toward wood-rotting fungi. On the other hand, the mono and di-chloro derivatives of certain coal-tar phenolic bodies are less volatile, less soluble in water, more resistant to oxidation, and much more toxic towards wood-rotting organisms than the unchlorinated parent substances. Chlorination of the cresols and xylenols gave the largest increases in toxicity, dichloroxylenol being the most toxic of all the substances tested. The chlorination of tar acids boiling above 270deg. Cent. resulted in a slight decrease in toxicity. In this case the increase in toxicity due to chlorination was apparently more than offset by a decrease in solubility in water.

ONE of the main drawbacks to the use of a two-stroke aviation engine running on petrol has been, according to Mr. H. B. Taylor, the loss of mixture which occurs through the exhaust port, which loss can only be overcome by an elaborate system of porting, or valve arrangement, or the injection of fuel during the compression stroke. The difficulties met with, however, have been so great that no successful two-stroke aviation engine has yet been developed, and in those types which have shown any promise the simplicity of the normally ported two-stroke engine has disappeared. The compression ignition engine is, however, concerned with the compression of air alone, and the simple ported two-stroke construction does not lead, in this case, to a direct loss of fuel through the exhaust ports. This class of engine therefore lends itself more readily to two-stroke working than does the petrol engine, and when successfuly developed may show very favourable weight/power ratios.

Miscellanea.

IT is proposed to organise a service of aeroplanes between China and Japan.

A NEW pulp and paper mill with a capacity of 70 tons a day is to be put up at Hantsport, Nova Scotia.

THERE are now under construction in the Fukien province of China well over 300 miles of modern roads.

THE long-distance telephone service between Tientsin and Mukden is to be extended to Kirin and Harbin.

A PLANT for dehydrating the Glauber's salts found at Palo, Saskatchewan, is to be put up at a cost of 100,000 dollars. The deposit is said to contain 20,000,000 tons of salt.

A COMPLETE new gas-making plant is being put in by the Nova Scotia Tramways and Power Company at Halifax, at a cost of 160,000 dollars. It is to be specially designed to utilise local coal.

THE Bureau of Public Utilities and Bureau of Public Works in Canton are formulating plans for the establishment of waterworks at Honam, opposite Canton city on the other side of the Pearl River.

THE suspension bridge over the St. John River at Grand Falls, New Brunswick, is to be dismantled. It was designed by Edward Serrell, London, England, and built in 1858. It was continued in use until 1913, at which time a new bridge was built.

THE output of coal by British Columbia collieries in the first eight months of the year aggregated 1,612,434 long tons, compared with an output of 1,453,561 tons in the corresponding period of 1926, an increase this year of 158,873 long tons.

THE amount of space applied for in the London and Birmingham sections of the British Industries Fair, which is to be held from February 22nd to March 2nd next, is now 403,488 square feet, as compared with 285,848 at the corresponding date of last year.

A RECENT study of electric power systems in Canada shows that the Dominion now possesses fifteen systems, which have a total output of 100,000,000 kilowatt-hours or more per annum. The total installed plant represents over 3,300,000 horse-power, of which 96 per cent. is derived from water.

THE management of the Mukden electric light plant has decided to replace the high-tension overhead wires with underground cables, so as to avoid accidents caused by damage or destruction of the wires in bad weather. A similar decision has been arrived at by the directors of the Peking Electric Light Company.

FOREST fires reported during 1926 caused direct damage amounting to about 26,900,000 dollars in the United States, as the result of 91,793 fires which burned over 24,300,000 acres of the lands of the country. More than 72 per cent. of the fires are known to have been caused by man and 12 per cent. by lightning. The causes of a little more than 15 per cent. are unknown.

A PROMINENT civil engineer of Montreal, Quebec, Mr. William Lemuel Scott, died on November 2nd, in his seventy-fifth year. He was born in Somerville, Mass., and graduated at Woodstock College, N.B., taking up his profession in Montreal. For some years he was engaged in railway work, and later he was appointed assistant engineer on the Montreal Ship Canal. He was for several years in the service of the Montreal Harbour Commission, and did important work in connection with the construction of the Quebec Bridge. During his later years he practised as a consulting engineer.

WORK is proceeding on dredging a channel in the river St. Lawrence, 10 miles long, on the south-east side of the island of Orleans, in order to enable vessels to reach the broader and safer North Channel of the St. Lawrence River. This route has now been fully buoyed and is available for navigation, even at extreme low water, by ships drawing 25½ft. Dredging will be continued to provide a channel 35ft. deep throughout at all stages of the tide. When the Department completes its undertaking to provide a channel 35ft. deep from Montreal to the sea it will have removed 127,135,808 cubic yards of material from the St. Lawrence River in the interests of navigation. Of this amount 101,500,000 cubic yards have already been removed, leaving only about one-fifth of the work to be done.

IT is not generally known, says the *S.A. Mining and Engineering Journal*, that, in addition to the search for oil now proceeding in Natal, South-West Africa and Portuguese East Africa, quite a big drilling programme is being carried on in Angola by American interests. According to a well-known engineer who has just returned from that country, Mr. J. Sinclair, who holds a concession from the Portuguese Government over a wide area, has spent in the last ten years no less than one and a-quarter million sterling in unsuccessful drilling throughout the concession. Heavy oil that did not, however, rise beyond the collar of the hole has been encountered, but oil in commercial quantities has not yet been found. The search is proceeding, however, and it is still believed by the Americans who are interested in the work that the first oil to be found in payable quantities in Southern Africa will be discovered in Angola.

THE question of deepening the Hai Ho channel, which connects Tientsin with the sea, is engaging the serious attention of the Chinese Ministry of the Interior. The silting up of the channel is said to have been caused chiefly by the sand and mud brought down by the Yung Ting River, which discharges its water into the Hai Ho through a section of the Grand Canal north of Tientsin. One of the plans suggested is to divert a portion of the water from the Yung Ting River by digging a canal to connect the Grand Canal in the neighbourhood of Peitsang with the Ching Chung River so that a large proportion of the silt-laden waters of the Yung Ting River can be diverted to the sea in the neighbourhood of Pehtsang through the Ching Chung River by means of a movable lock. This, however, would be only a temporary expedient, but could be carried out by an estimated expenditure of £200,000. A permanent and more effective plan has also been suggested, the execution of which would cost over £3,000,000.

HYDRO-ELECTRIC POWER HOUSES IN BRITISH COLUMBIA

(*For description see page 622*)

FIG. 1—POWER PLANT NO. 1 ON LAKE BUNTZEN

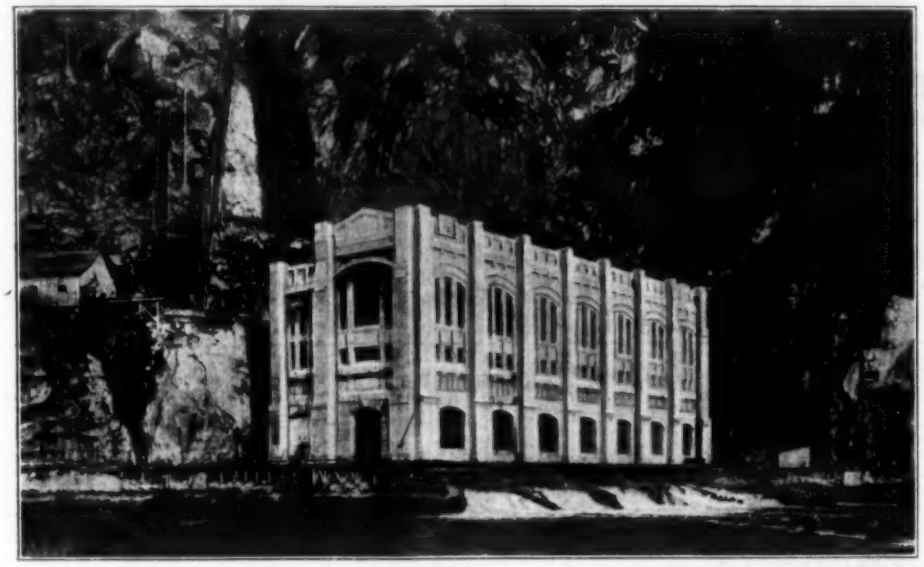


FIG. 2—POWER PLANT NO. 2 ON LAKE BUNTZEN

FIG. 3—POWER PLANT ON JORDAN RIVER, VANCOUVER ISLAND

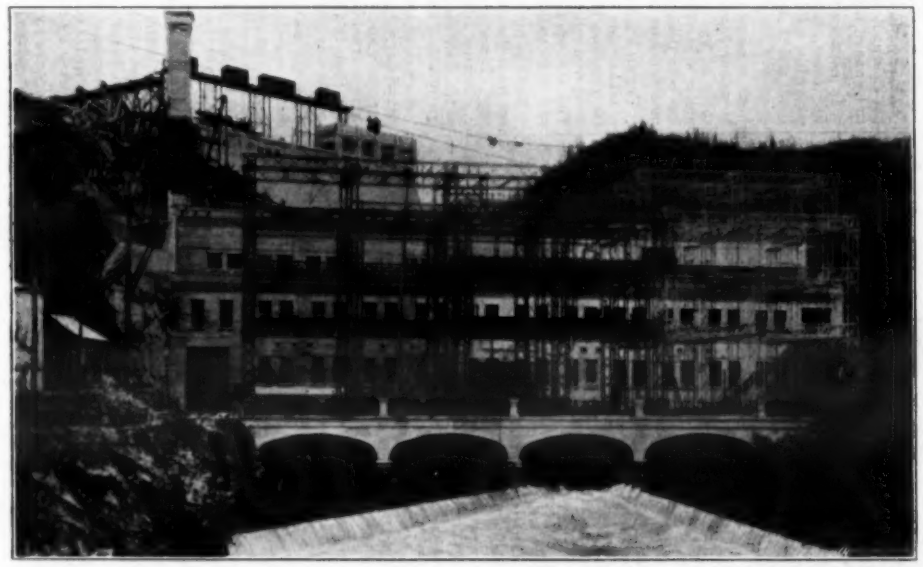


FIG. 4—POWER PLANT AT STAVE FALLS, STAVE RIVER

The Engineer

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THE ENGINEER.

DECEMBER 2, 1927.

The Economics of Speed.

THERE is nothing more difficult to estimate than the value of speed of transport. It is doubtful that it has, save in exceptional cases or circumstances, any intrinsic value at all. It enables us to save time—which we immediately dissipate in some other way. The man who likes to reduce a day's railway journey by thirty minutes and charges the railway companies with backwardness if they do not enable him to do so, is generally at a loss what to do with the half-hour when he has got it. The man who complains if his ship does not arrive in New York or Liverpool in the evening instead of the following morning is, in nine hundred and ninety-nine cases out of a thousand, unable to show that he has lost anything of consequence by the delay. To the average passenger speed by rail or sea is a form of luxury. If we consider the carriage of goods instead of passengers the answer is almost the same. Only in rare circumstances is speed of great consequence, and then often enough it is only needed to make up for delays caused elsewhere, perchance either in ordering or producing. Even the rapid transport of perishable goods is no longer a real necessity; a few more hours in a refrigerator car make no noticeable difference. The truth is that the love of speed is an animal weakness which man has inherited from the days when he saved his skin by the rapidity of his legs.

If, then, celerity of movement were the only reason that could be advanced for the attainment of high speeds by trains and ships, speed might be dismissed as, save in rare cases, a mere sporting event; which, by the way, it is to most travellers. It would not be worth the expense; for, as everyone knows, it is the last knot or mile per hour which costs the money. Railways and ships might provide it to satisfy and attract passengers, but they could only defend it as pandering to a common human weakness. Its importance is, in fact, to be sought in other directions. On railways the traffic density, a very important factor in economy, varies almost directly as the speed. If the time that a train occupies in a block can be halved, it is clearly possible to get twice as many trains through the block in a given time. Unfortunately, terminal delays upset the calculation not a little. That is why the rate of acceleration of suburban trains is of such vast importance. The railway companies have not provided an endless stream of fast trains in the morning and the evening just to satisfy the passengers' craving for speed. They run them fast because, by so doing, they can increase the traffic density and carry more people in a given time. But these are short journeys. The long passenger-haul at very high average speeds is not really economical; the passenger might get his fares cheaper if he would be content with a lower velocity. He has to pay for the speed, which is costly, not only in power, but in its effect upon permanent way material and rolling stock. A railway with a very small traffic density is mad to run fast trains. The slowest speed which will enable it to carry the daily consignments of goods and passengers is the most economical speed. It may have to attract passengers from other forms of transport and may find it necessary to offer speed as an inducement. Even then to be economical it must, and always does, run trains no faster than may be just sufficient to meet the end in view. Ships are not troubled with problems of traffic density on their highways, but they have to think of it in connection with ports, and in some cases the incidence of the tides is a ruling factor. In their case traffic density takes another form. The number of round trips which a Transatlantic steamer, for example, can make in the year is a measure of the profit she can earn. But sea speed is very costly in equipment and fuel consumption, and it is a nice economic problem to discover just what the best speed may be. At one time very high speeds were sought, but nowadays shipowners look more favourably on lower speeds. The intermediate ship—the ship which is neither as slow as a "tramp" or as fast as a "greyhound"—is the economical ship. It may be shorter, be provided with less propelling horse-power per ton, and consume less fuel. It turns round, indeed, fewer times, but the balance of profit is in its favour.

In the House of Lords a few days ago Lord Monkswell censured the railways because the average speed of trains was very little higher to-day than it was fifty years ago. He spoke of the attainment of speeds of 120 miles per hour. The average speed of expresses, which he had in mind, may be taken roughly as some 20 per cent. below their maximum speed. Hence Lord Monkswell's train would have to be capable of attaining about 150 miles per hour. We do not say that that velocity is incredible or impossible. But would it be worth while? To maintain an average speed of even 100 miles per hour the railways of the world would have to be reconstructed; gradients would have to be cut away, curves flattened, the permanent way strengthened, the bridges rebuilt. Would the public pay for all that? We cannot have twice the present average speed of our express trains for the same money. Would the cost of the extra speed be worth while? It takes about four hours to run from London to Manchester. Would a great many more people go to Manchester, at much higher fares, if the journey took only two hours? We doubt it. The very fact that maximum railway speeds have increased very little in fifty years is not evidence of the supineness or incapacity of railway directors so much as a convincing argument that the most economical speed has already been reached. No engineer doubts for a single moment that much higher speeds are possible. They will come for long journeys, just as they have already come for suburban journeys, when the economic conditions require them. That time is not yet.

The Modification of Raw Coal.

EFFORTS are now being made all over the world to attain improved efficiency in the utilisation of coal. From the engineer's point of view the improved efficiency which is sought is a matter of heat units. He desires to turn into work a greater number of the heat units in the raw coal. Others regard the meaning of improved efficiency from an entirely different standpoint. They are not primarily concerned with improving the utilisation of the heat units in the raw coal. Their object is two-fold. They seek to present the heat units in the form of a fuel which is more convenient for certain uses than coal in its native unaltered state. Simultaneously they seek to prevent the waste of those constituents of raw coal which are of no great value from the point of view of heat units, but which are of very great value commercially and scientifically by reason of their chemical characteristics. It is not, we think, sufficiently clearly recognised that these two aspects of efficiency in

the utilisation of coal, the engineer's aspect and what we may call the chemist's aspect, are in definite opposition. The chemist, in fulfilment of his double object of producing a more convenient fuel and of recovering useful by-products, sacrifices, and must of necessity sacrifice, some portion of the heat content of the raw coal. The engineer, bent on his task of using every possible heat unit in the coal handed to him by the miner, must utilise it in the raw state. Any treatment, mechanical or thermal, to which it is subjected, even although it involves no escape of heat units and no removal or waste of any portion or constituent, must by reason of the energy expended in the treatment show less than 100 per cent. efficiency when we cast up the final thermal, or energy, balance sheet. The use of coal in other than the raw state can never be justified solely on the grounds of heat units. The conversion of it into any form of gaseous, liquid or solid fuel involves an irrecoverable loss of thermal energy, and is justifiable solely on the grounds of convenience and the recovery of by-products.

Convenience and the recovery of by-products are excellent reasons for subjecting coal to mechanical or thermal treatment, but it would be as well if engineers, at least, realised clearly the price in heat units paid for such convenience and such recovery. The necessity for their doing so has been rendered somewhat urgent by recent developments in the treatment of coal and the almost complete silence so far preserved regarding the final thermal balance aspect of the processes employed. There is no secrecy and little uncertainty about the loss of heat units entailed in high-temperature carbonisation. From a ton of coal of, say, 14,000 B.Th.U. calorific value a modern gasworks will produce on the average about 10 cwt. of saleable coke at, say, 14,000 B.Th.U.; about 15,000 cubic feet of gas at, say, 520 B.Th.U.; and about 10 gallons of tar at say, 16,500 B.Th.U. per pound. The input of heat units is therefore some 31,360,000 and the output 15,680,000 + 7,800,000 + 1,750,000, or a total of 25,230,000. The thermal efficiency ratio is therefore of the order of 80 per cent. The remaining 20 per cent. of the heat units in the original coal are in part expended in heating the retorts and in part are lost in the sensible heat remaining in the coke, gas, and other products of the carbonisation process. Some of the sensible heat may be recovered in waste heat boilers, but the power so generated is employed on the works and therefore still remains an item on the debit side of the account. Turning to low-temperature processes of carbonisation, we find the data available for our thermal studies somewhat scarce and unsatisfactory. A thermal balance was published in the Fuel Research Board's report on its tests of the Parker plant at Barugh in 1924. The heat units in the coke, gas, tar, and spirit produced were returned as amounting to 94·8 per cent. of the heat units in the coal charged into the plant. That figure, if it represented the true or final heat balance, would be sufficient to place low-temperature carbonisation on an unassailable pinnacle. It is, however, only a partial representation of the true position. It omits reference to the very vital fact that the retort was externally fired and that some of the "low-temperature" gas to which a supply of separately generated producer gas was added was used to create and maintain the temperature at which the carbonisation was carried out. How much should be deducted from the efficiency of 94·8 per cent. to allow for this expenditure of heat units we do not know, for the consumption was not determined. There is, however, reason to believe that the true heat balance would have been less than the 80 per cent. characteristic of ordinary gasworks practice. An examination of the sources of heat loss in low-temperature carbonisation processes is stated by an authority on the subject whose opinion we must respect to show that the thermal balances of such processes cannot well be more favourable than that of high-temperature processes, and, taking into consideration the difficulty of recovering the heat from the low-temperature gases, that it is probably always a little less favourable. Passing finally to the various new processes for the "liquefaction" of coal, we find our studies still more hampered by the lack of precise data. The Bergius hydrogenation process gives yields which depend greatly upon the quality of the coal fed into the plant. Dr. Bergius has reported that certain brown coals leave only 1 per cent. of coal residue. Non-caking coals leave 10 to 15 per cent. With increasing carbon content the percentage of the material converted diminishes. On a fairly large scale 1000 kilos. of coal having 25 per cent. of volatile matter yielded on conversion about 43 per cent. of oil, 21 per cent. of gas, and 27 per cent. of residue. The remaining 9 per cent. or so consisted of water, ammonia, &c. Messrs. Graham and Skinner, investigating the Bergius process at Birmingham University, obtained figures which led them in the course of their paper before last week's meeting of the Institute of Fuel to base a financial examination of the process on a yield of 15 per cent. of motor spirit, 45 per cent. of fuel oil, and, so we infer, 20 per cent. of gas and 20 per cent. of residue. No information has been disclosed regarding the calorific value of the gas produced—except that it is high—and none regarding the heat value of the residue—except that it is low. Neither have we been told how much heat is expended in producing the high temperature and pressure under which the process is conducted or in generating the hydrogen taking part in the reaction. The yield of motor spirit and fuel oil indicated by Messrs. Graham and Skinner should account for about 25 out of the 31 million odd B.Th.U. in the ton of coal operated upon. It would, we believe, be too favourable to assume that the heat units in the gas and residue are just sufficient to produce the temperature, pressure and hydrogen required for the process. If, however, we assume that they are sufficient it would appear that the hydrogenation of coal by the Bergius process is about 80 per cent. thermally efficient. Evidence is not wanting which suggests that this figure is too optimistic. As regards the various other processes for "liquefying" coal in which use is made of water gas or carbon monoxide as an intermediate stage in the conversion, information on the aspect of the question which we are now considering is very meagre. In another paper presented last week before the Institute of Fuel, the authors, Messrs. Dunstan and Shatwell stated that Fischer and Tropsch, in their earlier experiments, succeeded in converting 27 per cent. of the heat units in the gas into heat units in the liquid product, and that the conversion has now, it is believed, reached 46 per cent. From the thermal balance point of view we must deduct from these figures the heat units expended in converting the original coal into the gaseous intermediary and in creating and maintaining the temperature and pressure at which the catalytic conversion is effected.

It is apparent from this brief and, of necessity, incomplete study of the treatment of raw coal that any process for the conversion of the material as mined into a gaseous, liquid, or improved solid fuel, involves a direct and probably a considerable loss of heat units, all items in the count being taken into consideration. That simple fact hardly required demonstration. Yet it seems to be lost sight of by certain authorities. It is sometimes advanced as an argument in favour of the Bergius and similar treatments that the oil produced has a high calorific value compared with that of the coal from which it is derived. Undoubtedly the calorific value of the oil is greater than the calorific value of the coal, but it must not be forgotten that it takes more than a pound of coal to produce a pound of oil. As the engineer regards the subject, any claim which processes for the gasification or liquefaction of coal may make to increase the efficient utilisation of our coal resources turns upon the fact that higher thermal efficiencies are obtainable from internal combustion engines than from coal-fired steam engines. Whether these increased engine efficiencies are great enough to overbalance the loss of heat units involved in converting the coal to gas or oil the data available at present are insufficient to enable us to determine. For the time being the assured advantages to be derived from any system for the modification of raw coal reside in the recovery of the by-products and in the relative convenience of distributing, handling, and using gaseous and liquid fuels as opposed to solid fuels. In the case of coal liquefaction processes we have the additional advantage that the country in which such a process is successfully established will, if it is endowed with ample coal supplies of a suitable kind, be freed from dependence upon overseas sources for its oil fuel requirements. These advantages are technically and commercially sufficiently important to justify all that has been done in the past and all the active research work of the present. Engineers, however, should have clear thoughts on the significance of the established and proposed processes of treatment from their own particular point of view as users of heat units.

THE improvement of Colombo harbour has proceeded to such an extent that there are now five berths for vessels drawing up to 33ft. of water.

In Canada with the Empire Mining Congress.

(From a Delegate to the Congress.)

No. IV. *(Conclusion).**

AT Sterco, on a branch of the C.N.R., on September 20th, we visited the open-quarry collieries of the Sterling and Coal Valley coal companies, seeing seams ranging from 30ft. to 100ft. in thickness, which at one point had been turned almost upside down in some far-distant geological age. At Cadomin we were taken by electric railway upwards of a mile into the heart of the mountain to see the coal face, and discovered later one of the most slummy-looking mining villages happened upon during our trip, which for the most part took us to camps where conditions of life were unexpectedly comfortable and civilised. Even here, however, people were happy and contented, and we were treated to a concert revealing considerable musical talent among the performers.

Continuing eastward, our journey took us to the oil and gas wells at Wainwright, Alberta, to the huge grain elevators and flour mills at Fort William and Port Arthur, after hurried glimpses at Saskatoon and again at Winnipeg. In Port Arthur, too, I had the opportunity of visiting the Provincial pulp and paper mills, where I was informed that the company contemplated the construction of a line of railway to its timber limits in order to save the present average wastage of 15 per cent. resulting from river floating of their pulp wood.

Our train eventually reached Noranda, in the Rouyn copper-mining district of north-western Quebec, on Saturday, September 24th, and we were entertained to an uproarious moose supper in a timber-built hall in the centre of the new town which the Noranda Mines Company is building for its employees. On the following day we made a journey through the mine and the new smelter which it was hoped would be ready for operation in upwards of a month's time. The production is expected to run at about 3,000,000 lb. of copper monthly, and the Horne mine output has already been contracted for sale to the British Metals Corporation. When custom ore is being offered by the numerous mining properties in the immediate neighbourhood and the Horne mine is further developed, the production of the smelter is expected to reach 60,000,000 lb. per annum, or nearly half the entire annual output for all Canada in recent years. This is a mining area barely four years old, where prospecting and development is proceeding at high speed on properties few of which have yet had time to reach the production stage. The Horne mine itself, belonging to the Noranda Company, has two development shafts—No. 1 to a depth of 328ft., and No. 2, 1000ft. away, 158ft. deep. There is a main operating shaft, 558ft. deep, which is to be continued deeper from the 500ft. level. Arrangements must be made in planning the hoisting equipment to keep separate the direct smelting copper ore, silicious fluxing ore, concentrating ore, zinc ore, and waste rock. Three-ton cars of the Hollinger type are to be used in handling the ore from the underground chute to the crushing plant bins on the surface, where a trip of seven cars will be dumped at once in a rotary tipple. Tramming underground and on surface will be done with three Atlas storage-battery locomotives, which are short enough to go on the mine cage.

The mill and smelter, the daily capacity of which will be 1000 tons, is expected to be completed in November. It includes a primary and secondary crusher, sample mill, eight roasters, two heat recuperators, two reverberatory furnaces, using pulverised coal as fuel, two Pierce-Smith converters, two casting machines for casting blister copper, two 40-ton electric cranes for the converter aisle, and one 10-ton electric crane for the dispatching room. There is to be a Cottrell electrical precipitation plant, and the stack is 422½ft. high, 31ft. wide at the base and 20ft. wide at the top. There are large machine shops and a power-house with two 2500 cubic feet 100 lb. Belliss and Morcom air compressors, two 20,000 cubic feet, 20 lb. Ingersoll-Rand blowers for the converters, electrically run, and two motor generator sets. Power is brought in from the plant of the Canadian Northern Power Corporation, 50 miles away, on the Quinze River, at 110,000 volts, 25 cycles, and is reduced in a sub-station to 12,000 volts before being sent to the mine or smelter, where it is reduced to 550 volts for use at the motors. There are 4 miles of standard gauge railway track in and around the plant.

Leaving Noranda on Sunday afternoon, the trains reached Quebec after breakfast on the following morning—a bitterly cold wet day, and here were held the last of the technical sessions associated with tour "A." A visit to the Montmorency Falls occupied the afternoon, and next morning found us at Thetford Mines, after crossing the great Quebec Bridge at midnight. Readers may be reminded that this—one of the greatest triumphs of Canadian engineering—stands 150ft. above water level and has a total length of 2830ft., with a single span 1800ft. in length, the longest in the world. The centre suspended span, which was built 3 miles below the bridge and floated into place for hoisting, has a length of 88ft., and when

* No. III. appeared November 25th.

first hoisted collapsed into the river owing to a miscalculation. The bridge provides room for two steam railways, two electric trolley lines, two highways, and two sidewalks for foot passengers, and the total weight of metal that was employed in its construction was 65,000 tons.

At Thetford Mines we spent the morning in the heart of the asbestos mines and mills of the Province of Quebec, which formerly possessed a virtual monopoly of the supply of this mineral. The rock is obtained by quarrying in large open holes from which it is taken out either by cable derricks or by trains of railway cars entering through inclined shafts. Milling involves the crushing of the rock in mills plastered thick with white dust, screening for the various grades of fibre, and the weighing and bagging of the product for export. The huge mounds of waste asbestos sand are as characteristic a feature of the landscape here as those white mountains of china clay waste in certain parts of Cornwall.

Congress tour "A" came to an end at Montreal, after reaching which city the writer spent a further week in visits to the coal mines and steel plants of Cape Breton Island, the oil and sugar refineries near Halifax, N.S., the hydro-electric power plants, aluminium wire works, calcium carbide plant and paper mills in the neighbourhood of Shawinigan Falls, and notably the huge hydro-electric power developments and aluminium plant at Arvida, in the Lake St. John District of Quebec.

My first visit in the Lake St. John District was to the great hydro-electric power plant at Isle Maligne, on the Grande Décharge of the Saguenay River, not far from where the river leaves Lake St. John—a huge natural reservoir of 375 square miles with a tributary water supply area of 35,000 square miles. Ten 45,000 H.P. vertical generators are already in place, with space for two more, making the total possible installation in this one great building 540,000 H.P. To concentrate the flow at this point the second of the two outlets from the lake which come together to form the river Saguenay—the Petite Décharge—was blocked and four spillways and the power-house were erected on the Isle Maligne after a stupendous struggle with this wild torrent. Ownership of the plant is divided in varying proportions between the Aluminum Company of Canada, Messrs. Price Bros., pulp and paper manufacturers, and the Shawinigan Water and Power Company, which concerns have long-term contracts for the supply of power for their various purposes.

The Aluminum Company of Canada is, however, engaged on a very much larger development on the opposite side of the river Saguenay from its manufacturing plant, about 4 miles distant. There at a power-house at the mouth of the Shipshaw River water carried from the Chute à Caron, 20 miles below stream from Isle Maligne, will be conveyed by flume to ten huge 80,000 H.P. generators, producing 800,000 H.P. in all, the whole of which will be required for the enlarged factory that is to be ready at the same time. The existing factory, when I visited it, had a weekly output of a million pounds of pig aluminium, and it is reckoned that the output of the immense plant which will utilise the Chute à Caron power will approximate to 180,000 tons annually, or 90 per cent. of the aluminium consumption of the world at the present date. I saw the entire operations of the mill, the manufacture of the petroleum coke electrodes, and the electrolytic separation and pouring of the metal, and was able to admire the foresight of the company in securing from the Quebec Government the concession of land, 8½ square miles in area, on which to construct its industrial plants and to plan a charming garden city for its workers. The bauxite for the plant is being brought by tramp steamer up the Saguenay River from British Guiana to the company's own wharf on the river, where the frontage is 4 miles long, the vessels taking back wood pulp and paper from the local mills owned by the company itself or other concerns. At the present moment this ore is going into store, and the plant is working on dried and purified bauxite imported from the United States.

The total available water power in the Lake St. John District—possibly the cheapest in the world—is estimated at 1,450,000 H.P., and of this the Aluminum Company in its two plants will control no less than 1,340,000 H.P. The aluminium plant which I saw at Shawinigan Falls has a monthly production of about a million pounds of ingots, wire rods and wire, and also steel-cored aluminium transmission wire.

I visited the two plants of the Shawinigan Water and Power Company, one of them containing a number of comparatively old machines still giving good service, the total output of No. 1 plant, with generators ranging from 5000 H.P. to 11,500 H.P. each, being 58,500 H.P. No. 2 plant has six 20,000 H.P. units and one new vertical 45,000 H.P. generator, with space for two more, so that the total capacity of the two plants when completed will be 293,500 H.P. The plant at Grand' Mère, adjoining the Laurentide paper mill, which I was taken through, has six 20,000 H.P. and two 22,000 H.P. units, and room for another of the latter size, a total capacity at present of 164,000 H.P., but lower down the stream, 7 miles away, the La Gabelle plant has a capacity of 150,000 H.P. The total output of the system maintained by the Shawinigan Company north and south of the St. Lawrence reaches no less than 580,000 H.P., much of this being carried across the river by a high-tension transmission line as far south as Sherbrooke, in the asbestos country.

The colliery of the Dominion Coal Company, which I visited during my trip to Cape Breton Island—No. 1–B, as it is called—is a submarine mine, stretching more than 2 miles seaward at a depth beneath the sea bed of about five to six hundred feet. There is a main haul of 2 miles, and the colliery seems remarkably well designed for development and speed in transport and hoisting. Electricity is employed both underground and at the surface, and elaborate precautions are taken to obviate gas explosions, the track and walls being stone-dusted throughout and haulage conducted in the main intake airway.

The colliery has a daily output of 3000 tons, and an estimated life of from 125 years on the upper seams to 240 years if others are added.

Little space remains for a description of the steel works and coke oven plant of the Dominion Steel Corporation, which I examined on the same day. Its dimensions may be gauged from the fact that it has a yearly output of 580,000 tons of pig iron, 420,000 tons of steel ingots, 375,000 tons of blooms, 150,000 tons of billets, 240,000 tons of rails, 90,000 tons of wire rods, 60,000 tons of wire nails, fencing, &c., together with capacity for the production of 150,000 tons of ship plates in a mill which was established for wartime construction and has never operated since.

The principal items in the plant—together with the complementary works of the Nova Scotia Steel and Coal Company at Sydney Mines, also a subsidiary of the British Empire Steel Corporation which controls the collieries as well, and in addition the Wabana iron ore mines of Bell Island, Newfoundland—are:—Two Baum coal washers capable of treating 4000 tons daily; 150 non-recovery coke ovens, with appliances for the utilisation of surplus gas; 200 improved Otto-Hoffman recovery coke ovens; 180 Koppers recovery coke ovens, saving tar, benzol, naphtha, sulphate of ammonia, and surplus gas, which, with blast-furnace gas, is the principal fuel of the plant; eight standard blast-furnaces, with an annual capacity of 750,000 tons of pig iron; 15 open-hearth furnaces; three open-hearth mixers; two basic Bessemer converters of 15 tons capacity each; a 35in. blooming mill; a 28in. rail mill; a Morgan continuous wire rod mill; a Morgan semi-continuous bar and rod mill; a 16in. merchant bar mill; a 10in. plate mill; a Harmet fluid compression plant, producing steel ingots up to 30 tons weight; and a complete plant for manufacturing wire, wire fencing, nails, &c., and for galvanising. The various power plants, utilising surplus gas or waste steam from the mills, generate upwards of 15,000 kW of energy.

The plant has also iron and brass foundries, machine shops, fire-brick works, and unloading piers capable of handling into the company's own vessels or discharging therefrom 10,000 tons daily. The company's fleet of ocean-going steamers, fourteen in number, has a total tonnage of 70,000 tons.

Obituary.

HAROLD DICKINSON.

MUCH regret is felt in engineering circles in Lancashire at the untimely death of Mr. Harold Dickinson, City Electrical Engineer of Liverpool, which occurred at his home in Wallasey on Sunday last, November 27th. Mr. Dickinson had been ill for some time, but continued to carry on his duties until quite recently. He was a native of Wolverhampton and was educated in Birmingham. After managing several minor electrical undertakings, Mr. Dickinson became associated with the Yorkshire House-to-House Electricity Company as engineer and manager, a position he retained until the company was purchased by the Leeds Corporation in 1898, and he remained in charge of the business till 1912, during which time he was responsible for the extensions to the generating works and distributing system.

Mr. Dickinson was appointed City Electrical Engineer of Liverpool in January, 1913, and in March, 1922, he was given the post of City Lighting Engineer. During his period of service at Liverpool great developments took place in electrical engineering, and the city under his guidance advanced with the times. The generating capacity of Lister Drive generating station was greatly increased. When he took charge the output was 8400 kW, but that was soon increased to 33,000 kW, while in 1919 two further 12,500-kW turbo-alternator sets were installed in place of four 2000-kW sets, thereby increasing the total output of the city's two generating stations to 70,000 kW. These increases enabled the Corporation to defer further expenditure on a new power station for several years. Mr. Dickinson was responsible for the installation of static sub-stations in many large works and residential portions of the area. There are now 120 of these sub-stations in use. He was also a pioneer in the erection of rotary converter automatic sub-stations connected to the lighting network. Nearly 100 miles of roadway in Liverpool are now illuminated by electricity.

Mr. Dickinson was a member of the three institutions of Civil, Mechanical, and Electrical Engineers. He was president of the Liverpool Engineering Society in 1917–18, and in 1920–21 chairman of the Liverpool sub-centre of the Institution of Electrical Engineers. In July last the Liverpool University conferred on him the honorary degree of Master of Engineering.

SIXTY YEARS AGO.

IT is comforting and encouraging at the present moment to learn that prophets of approaching industrial decadence were as prevalent sixty years ago as they are to-day. Since 1867 British industry has not wasted away in spite of those who foretold that the moment was very close at hand when we would sink to a fourth-rate place among the industrial nations. British industry during that period greatly expanded and experienced considerable prosperity, in spite of the fact that there were those who maintained that it was slipping through our fingers to our foreign competitors. Doubtlessly, sixty years hence the same story of false prophecy will fall to be related. Dealing with the subject in our issue of November 29th, 1867, we commented upon the fact that the prophets of evil were distinguished by the vagueness and indecision characteristic of their kind from time immemorial. That we had a good deal to lose from foreign competition, we did not dispute, but we argued that our mechanical engineers could still find crumbs of comfort by closely examining the doings and productions of their French and Belgian rivals. In the construction of machines of every kind, France and Belgium, we stated, were quite ten years behind us. They were behind us in finish, material and general workmanship. The Paris Exhibition of 1867 showed that very few French machines and tools would bear rigid inspection. Surfaces, we pointed out, could be scraped and polished until they looked very pretty without being true, and designs might be very ingenious without manifesting anything more than the stupidity, perverseness and eccentric predilection of the designer. As regards scraping, we recorded that the purely incidental marks left by the scraping tool were regarded by French engineers as a means of decorating the flat surfaces of their machines. Surfaces were scraped—if they were visible—sometimes with fantastic patterns, purely for the sake of beauty and without securing a degree of flatness that would have passed a common straight-edge test. In place of the fine scraped joints made tight with a minute film of red paint, such as the Penns and Maudslays of this country used, French engineers used wire gauze and brown paper packing, just as in the days of James Watt, when cylinder lids were made tight with pasteboard. It was possible, we concluded, that if we knew more concerning the cost of repairs in the French Navy and merchant service, in French factories and on continental lines, we would dread foreign competition less. Perhaps, however, it was on the whole best that we and our rivals should remain in ignorance of each other's secrets. A little more light might, we argued, stimulate the one party and encourage laxity and slovenliness in the other.

PERKINS AND HIGH-PRESSURE STEAM.

MR. LOFTUS P. PERKINS established a link with a famous engineer of a hundred years ago when he talked to the members of the Junior Institution of Engineers on November 25th about pioneers in high-pressure steam, and some of his accounts of the achievements of that inventive genius, Mr. Jacob Perkins, in the reign of George III. were momentarily startling to many 1927 engineers. In these days when a boiler engineer likes to work at pressures of 300 lb. per square inch, and eagerly reads about boilers designed for 3000 lb. per square inch, he is apt to disregard passing references to steam pressures of 2000 lb. per square inch being generated and used three generations ago. Mr. Loftus P. Perkins brought it home to them, however, that boilers and engines for really high pressures up to 2000 lb. per square inch were made by Mr. Jacob Perkins and his descendants from the year 1822 onwards, and that some of them had continued in operation until 1919. It was with a spirit which puts modern ordnance activity to shame that the Duke of Wellington declined to make use of the Perkins steam gun, capable of discharging musket balls at the rate of 1000 a minute, on the ground that it was too destructive. Mr. Loftus P. Perkins exhibited a number of illustrations and mementoes of the work of these pioneers, including a piece of copper tube, ¼in. internal diameter, which had been used to pass sufficient high-pressure steam to develop 40 H.P. References were made to steam vessels like the Emily, Antracite, and Salamander, which owe their distinguished place in the history of steam vessels to the Perkins family. Mr. W. J. Tennant occupied the chair at the meeting, and many members and visitors took part in the discussion, some being users of Perkins' high-pressure engines. Mr. A. W. Marshall said that Perkins' work went to show that steam engineering generally up to now had only been "hot water engineering"—a definition applied by Colonel Crompton.

BOOKS RECEIVED.

The Institute of Fuel: List of Council and Members. London: The Institute of Fuel, 53, Victoria-street, S.W. 1.

Steel and its Heat Treatment. Third edition. By D. K. Bullens. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 25s. net.

The American Society for Testing Materials: Index to "Proceedings," Volumes 21 to 25 (1921–1925). Philadelphia: The American Society for Testing Materials, 1315, Spruce-street, U.S.A. Price, 2·50 dollars paper bound, 3·50 dollars cloth bound.

A NEW AND AN OLD FORM OF SEXTANT

C. F. CASELLA AND CO., LTD., LONDON, MAKERS

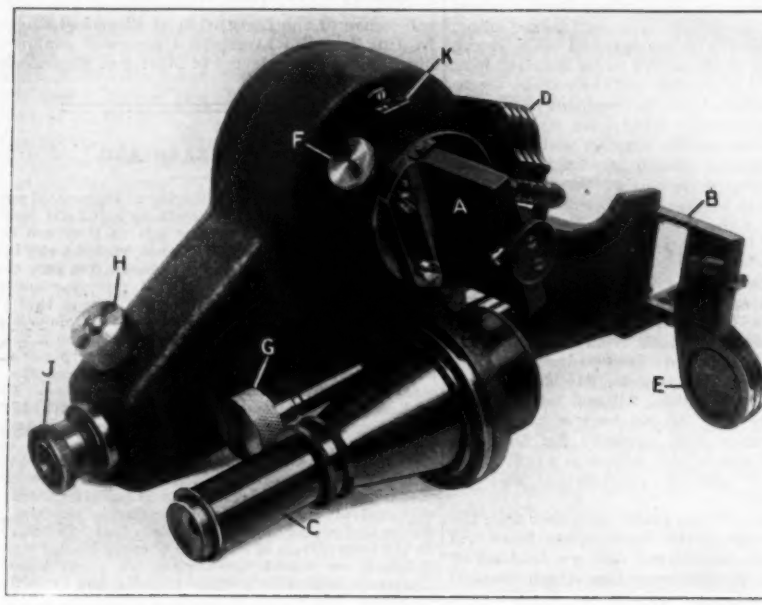


FIG. 1

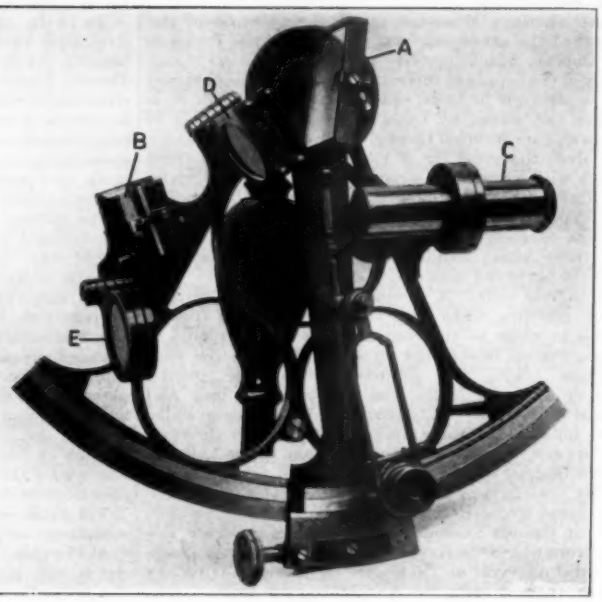


FIG. 2

A New Form of Sextant.

THE general principle of the sextant has undergone little or no change since it was invented in the early years of the eighteenth century, nor have the details of construction altered much during the past 120 years or so. While the simplicity of the mode of action of the instrument sufficiently accounts for the absence of change in its general principle, it cannot be said that the all but complete absence of development in its detail design is to be explained by an early perfection of form. At sea, where it finds its chief employment for the determination of latitude and longitude, it is not an easy instrument to handle without considerable practice, while the open exposure of its scales and all its working parts to the full influence of the sun and weather introduces a considerable risk of error and damage. Moreover, once the instrument has been made the user has to place reliance upon the accuracy with which the manufacturer has divided the scales and centred the axis about which the vernier arm turns. No means are provided as in other instruments fitted with a divided circle for eliminating the effect of these two sources of error by taking the mean of opposite readings. The best that can be done is to furnish each instrument with a table of errors based on measurements of its accuracy by the National Physical Laboratory or other authority. In this connection, it may be noted that to fulfil the requirement that the error in the reading shall not exceed 40 seconds of arc necessitates that the axis of a 7in. sextant should be correctly centralised to within one-thousandth of an inch. It is doubtful whether the original decentralisation error remains constant. There are, in fact, grounds for believing that the unequal exposure of the different parts of the instrument to the sun adds to the error each time the sextant is used in the Tropics.

The new form of sextant illustrated herewith has recently been patented and placed on the market by C. F. Casella and Co., Ltd., 49, Parliament-street, S.W. 1. In order that its distinctive features may be properly appreciated, it may prove useful if we describe briefly the design of a modern sextant of the orthodox type.

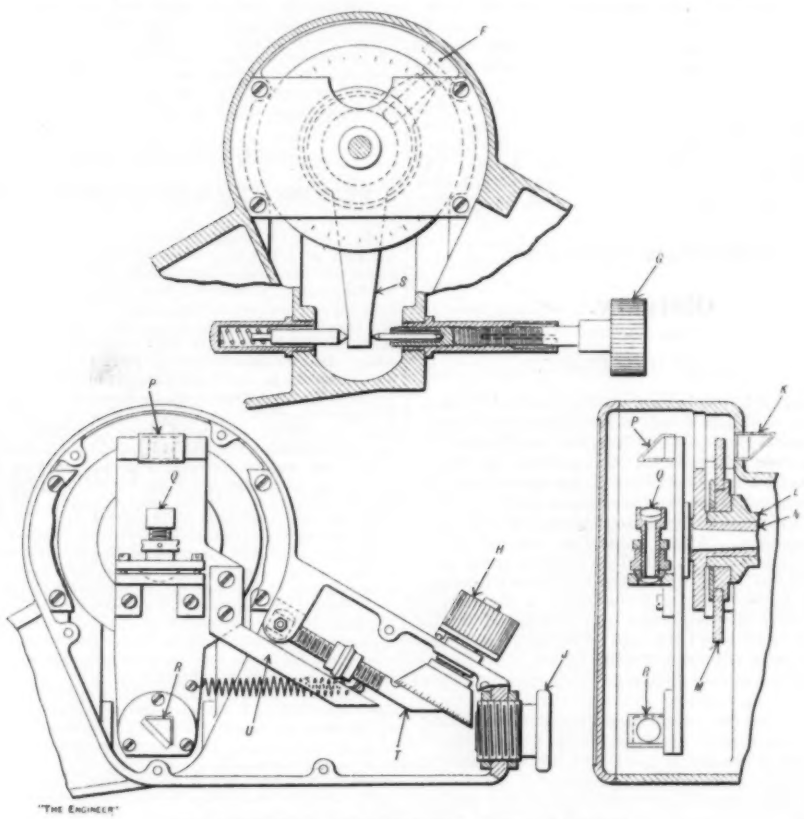


FIG. 3—INTERNAL ARRANGEMENT OF NEW SEXTANT

An ordinary standard pattern of sextent, as made by Messrs. Casella, is illustrated in Fig. 2. On the far side of the main frame or limb is to be seen the handle whereby the instrument is held by the observer with his right hand, while with his left he adjusts the vernier arm. The main frame is a gun-metal casting with a divided arc of silver inlaid in the face of the curved portion at the foot. The upper corner of the casting is bored to receive the axis about which the vernier arm turns. In precise terms, the decentralisation error referred to above is the error introduced by lack of exact coincidence between the axis of the vernier arm and the centre about which the arcual scale is divided. In addition, the reflecting surface of the index mirror A, which is attached to and moves with the vernier arm, ought to be accurately coincident with the axis about which the vernier arm turns. The horizon mirror B is fixed to the main frame, and in line with its centre is the telescope C. The index mirror is silvered all over, but the horizon mirror is silvered only over half its width to one side of a vertical line, the other half being clear glass. At D and E tinted glasses are provided, which may be swung one or more at a time into the lines of sight in order to reduce the glare from the sun and from the horizon. The vernier arm at its lower end carries a clamp and a tangent screw, whereby the arm may be locked roughly in position, and then adjusted finely. A microscope is slung from the arm to faciltate the accurate reading of the vernier scale.

The zero end of the arcual scale is towards the right. When the arm is set at the zero graduation, the two mirrors are parallel. To take a sight, the operator directs the instrument in such a way that he can see the horizon through the telescope and the unsilvered portion of the horizon mirror. The vernier arm is then moved until the image of the sun—or star—as reflected from the index mirror on to the silvered portion of the horizon mirror and thence into the telescope, appears to touch the horizon.

Main Scale 51° 30′ *Micrometer Drum* + 1′ 6″
Actual Angle 51 42′ 8″

FIG. 4—IMAGE SEEN IN EYEPIECE

The measurement sought—the angular elevation of the sun or star—is twice the angle through which the vernier arm has been moved from the zero position. The arcual scale has its half degrees marked as degrees in order that the elevation may be read directly.

The fact that the angle sought is twice the angle moved through by the vernier arm, makes the sextant twice as difficult to read to a given degree of accuracy as other instruments using a divided circle, such as a theodolite. The multiplication factor is introduced by the double reflection suffered by the image of the sun. The primitive sextant read directly against a natural scale of angles, for in it there was only one mirror. It was almost useless at sea, for any movement of the instrument in the vertical plane, such as that caused by the rolling or pitching of the ship, resulted in loss of contact between the image of the sun and the horizon. The modern double reflecting sextant maintains the contact if the instrument is tilted in the vertical plane. This fact enables accurate readings to be obtained with the instrument simply held in the hand without fixing it to a tripod or levelling it in any way. This advantage is far too great to discard for the sake of securing a natural scale of angles.

Messrs. Casella's new sextant—Fig. 1—is, by comparison with the ordinary form, small and light. Externally, it consists of a cadmium-plated, aluminium alloy casing, carrying the index mirror A, the horizon mirror B, the

telescope C and the tinted glasses D E. These parts operate in precisely the same way as the corresponding parts of the ordinary type. With the exception of three control knobs F G H, a magnifying eyepiece J and an illuminating prism K, all the rest of the gear is contained inside the casing. There is no handle, the casing itself being sufficiently small to permit of its being readily held by one hand. The internal scales illuminated by light received through the prism K are read through the eyepiece J. They are read with the left eye, while simultaneously the right eye is observing the sun through the telescope C. In the ordinary sextant simultaneous observation and reading are not possible. It will be noticed, too, that whereas the ordinary sextant is held in the right hand, the new design is held in the left leaving the right free to operate the control knobs.

The index mirror is mounted on an external circular plate, which is carried at the end of an internal sleeve L—Fig. 3—to the other end of which is fixed an annulus M of glass engraved in degrees and half degrees. The sleeve L is carried by a hollow spindle N projecting from a spider plate fixed across the casing. Light entering the prism K is reflected through the scale on the glass annulus into the prism P. Thence it is reflected downwards through an object glass Q into another prism R, which turns it into the eyepiece J. The prisms P and R and the object glass Q are mounted on a plate, which is provided with a spindle fitting within the bore of the hollow spindle N.

The knob F—Figs. 1 and 3—screws into a ring surrounding the mirror and annulus sleeve L. If this knob is unscrewed the mirror and annulus can be rotated by means of the milled button fixed to the edge of the mirror frame —see Fig. 1—until the image of the sun is brought down roughly on to the horizon. Fine adjustment is then secured by screwing up the knob F in order to lock its ring to the sleeve L. The ring referred to has a tail piece S, whereon the adjusting screw G, aided by a spring-pressed plunger on the other side exercises delicate control. Both during the rough adjustment and during the fine adjustment by means of the screw G, the optical system P Q R remains stationary. Its spindle although coaxial with the mirror and annulus sleeve L, is shielded throughout its length by the fixed hollow spindle N, and therefore does not receive any frictional drag when the mirror, the sleeve L and the glass annulus are turned either from the knob on the mirror frame or through the agency of the fine adjusting screw G and the clamping screw F.

The eyepiece J is provided with two horizontal hair lines—see Fig. 4. The image seen through it is a vertical projection of the small portion of the glass annular scale that has stopped within the view of the prism P. The portion seen covers a range of 5 deg. or 6 deg. In general, a degree or a half degree mark will not fall exactly between the hair lines. Means must therefore be provided to permit the excess or deficit to be read by a micrometer attachment. This micrometer attachment is controlled by the knob H—Figs. 1 and 3. The spindle of this knob bears against the end of a lever T, which is hinged at its other end to the casing. A nut with a knife-edge raised round its edge bears against a tail piece U attached rigidly to the plate carrying the optical system P Q R. Contact between the tail piece and the nut is maintained by means of a spring extending from the plate of the optical system to a point on the casing. The adjustment of the position of the nut on the lever T is a makers' adjustment. The user is not required to touch it.

According as the knob H is turned to screw its spindle down or up, so will the movement given to the lever T and tail piece U tilt the optical system clockwise or anticlockwise. The effect of such tilting is to bring the prism P opposite a slightly different portion of the glass annular scale. As seen through the eyepiece J, the glass scale image appears to move up or down, but in reality it is the optical system and not the mirror and annulus system, which is moving.

The movement of the knob H is continued until a degree or half degree division appears to divide the space between the hair lines. The reading sought is then the number of this degree or half degree division plus—or minus—a quantity which is proportional to the amount the knob H has been turned. The magnitude of the addition—or subtraction—is obtained from the graduated edge of a celluloid or other transparent conical skirt surrounding and rotating with the screw of the knob H. A small portion of the edge of this skirt comes within the illuminated field of vision through the eyepiece J, and appears —as shown in Fig. 4—as a graduated arc at the top of the disc. The graduations are in minutes and tenths of minutes, and are read against an arrow point fixed in the field of vision. Although the celluloid skirt rotates with the screw of the knob H, the details of its attachment are such that it does not move parallel with the screw axis as the knob is turned. The edge of its image as seen through the eyepiece does not descend or rise as the screw is turned, but remains as shown in Fig. 4, just touching the point of the arrow. Before each observation with the sextant the micrometer scale is set to read zero.

The chief advantages of this new form of sextant are its lightness and general handiness, the full protection which it affords to the scales, and the fact that it permits observation and reading to be made simultaneously. The angle to be determined is as in the ordinary type of instrument, twice the angle turned through by the index mirror, but the optical magnification of the scale is such as to overcome the difficulty caused by the compressed scale of the ordinary sextant. The design suffers from the defect referred to as characteristic of the common pattern, namely, it does not permit the decentralisation error to be eliminated by taking the mean of opposite readings. For ordinary navigational purposes, however, the construction is such as to enable the scale and mirror pivot to be located very accurately. If it is desired to take mean readings for the purpose mentioned, a relatively simple modification of the design can be adopted. In this design the prism P is replaced by two prisms situated to view the ends of the horizontal diameter of the annular scale. Coincident with the centre line of the glass annulus there is a third prism which reflects the images received from the first and second downwards into the object glass Q. By these means the eyepiece J receives the images of two short sections of the glass scale instead of one. These sections are diametrically opposite each other on the scale, and by taking the mean of their readings the effect of decentralisation of the axis is eliminated. A sextant of this type has not, we understand, so far been made. It is not likely to be required for other than very exceptional conditions.

Testing the Hardness of Gear Wheel Teeth.

DEVELOPMENTS in the hardening and case hardening of gear wheels followed by processes for the grinding of the working faces of the teeth have rendered it desirable to have some means of determining the hardness of the working faces with a view to detecting imperfect hardening, carburising or grinding. Previously it has scarcely been possible to do more than test the hardness of the ends and tops of the teeth. In order to determine the hardness of the actual working faces it has generally been necessary to remove the tooth and therefore destroy the whole wheel.

An appliance designed to overcome the difficulty we

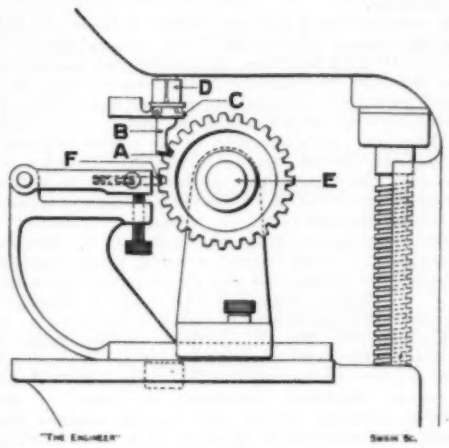


FIG. 1

have indicated has recently been produced by Vickers Ltd. as an adjunct to their diamond hardness testing machine. That machine, as exhibited at the British Empire Exhibition, was illustrated and described in our issue of September 12th, 1924. It makes use of a pyramidal diamond indenting tool, which, when a control lever is pulled, is automatically applied to the work in such a way that the indenting force increases during a period of about 20 seconds from zero up to the maximum of 50 kilos. The full load is maintained on the diamond for about 10 seconds, and is then automatically released. After the indentation has been made the table carrying the specimen is lowered sufficiently to permit a microscope forming a part of the machine to be swung into position to measure the size of the impression. The size is taken as the length of the diagonal between two opposite corners of the square image of the impression, and by means of tables can be converted

FIG. 2

directly into the hardness figure. The figure obtained is claimed to be strictly comparable with that given by a high class Brinell test.

In the new attachment the mount of the diamond—as shown in Fig. 1—is cut away so as to permit the diamond to reach the pitch line of a tooth without interference from the next succeeding tooth. The diamond A is set in the mount B, which is secured to a plate C hinged to a spring cap D. The wheel is carried on a spigot E and is positioned by a spring stop F. Both the spigot and the stop are adjustable relatively to the base, and consequently any portion of the tooth face from the pitch line outwards may be tested. Once the adjustment has been correctly made, say for the pitch line, the succeeding teeth of the wheel or the teeth of similar wheels will be correctly located for testing at the same point of their faces.

On repetition work the wheel is placed on the spigot and an impression with the standard 50 kilos. load is made on one tooth. The stop F is then withdrawn and the wheel rotated anticlockwise until the next tooth to be tested comes into position. The hinging of the plate C causes the diamond and its mount—as shown in Fig. 2—to swing out of the way as the wheel is being rotated on its spigot. When a series of impressions on different teeth has been made in this way, the table of the machine carrying the specimen is lowered to the extent required to allow the microscope to be swung into position for measuring the size of the impressions—see Fig. 3. The 1½in. objective

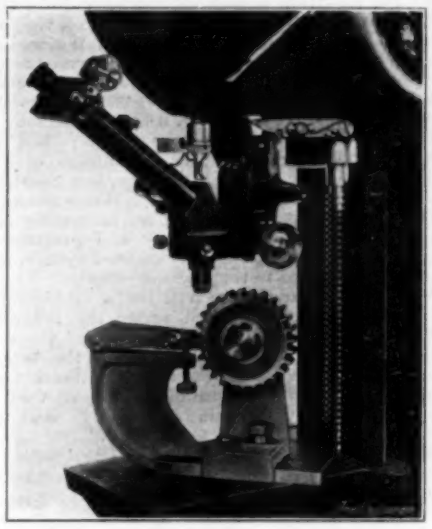


FIG. 3

supplied with the microscope is employed for this purpose. Once the microscope has been correctly focussed for one tooth it is in correct focus for all the others. It is stated that on repetition work accurate tests can be carried out at the rate of 200 per hour.

CENTRIFUGAL CASTINGS FOR DIESEL ENGINES.

AT the November meeting of the Diesel Engine Users Association, which was held on Friday last, November 25th, Mr. J. E. Hurst gave a paper on "Centrifugal Castings for Diesel Engines," in which the special system of pouring molten cast iron into rapidly rotating metal moulds was dealt with. The main principles of the centrifugal casting process were described by the same author in a paper published in THE ENGINEER of July 21st, 1922. On Friday last, Mr. Hurst dealt chiefly with the newer development of his process at the Thorncliffe Works of Newton, Chambers and Co., Ltd., near Sheffield, which has already been referred to in our issue of September 16th last. The cylindrical castings produced by this new method are made in low-silicon, low total carbon irons, with the maximum of combined carbon compatible with commercial machinability. As applied to the production of large internal combustion engine cylinders, the metal mould normally used in the centrifugal process is replaced by a refractory sand-lined mould made up in the ordinary way using a pattern or a skeleton pattern slit for sweeping boards. The mould is made up in a special container, capable of being mounted on the centrifugal casting machine. Exactly as in the case of the metal mould, no core is used and the mould is spun about its horizontal axis, at a speed of about 2500ft. per minute, and the molten metal is introduced. All the advantages by way of solidification of the metal in the centrifugal process as and against vertical sand casting are claimed to be secured. The refractory mould enables the low silicon content irons commercially machinable to be obtained easily, and, in addition, modern oil engine liners with ports, waterway passages and flanges can be dealt with, the casting of which would otherwise be unpracticable in metal moulds. During the process of cooling down the inside of the casting is subjected to a wet blast, which is suitably regulated. The assisted cooling results in a sorbitic structure, which has given the material its name of "spun sorbitic iron," which possesses properties of resistance to both wear and growth. The fact that this special treatment is applied to the inside or wearing surface of the liner is of practical importance. It has also been shown that the somewhat slower cooling of the casting does not affect the fine grain of the irons produced by the centrifugal method of casting. Among other castings there are now produced liners and sleeves for automobile engines, and experiments are being carried out with a view to producing internal flanges and eventually pistons with a solid head.

ON Thursday evening, December 1st, Mr. R. Borlase Matthews read a paper before the Institution of Electrical Engineers on "Electric Ploughing," illustrated by interesting cinematograph films showing British, French and German practice. In England electric ploughing is still uncommon. As early as 1910 a double winder rope system plough was employed in Nottinghamshire. Next an electric plough was installed on the author's farm, and since then Major A. McDowall, in Scotland, has developed one. On the Continent over 200 electric ploughs are in use. In view of the proposed wider rural distribution of electricity, electric ploughing, Mr. Matthews said, was becoming a practical proposition here. An electric plough the author contended, would accomplish up to thirty acres per day, as compared with the one acre per day of a team of horses. Among the novel features to which reference was made was the support in the air, by means of a balloon, of the electric cable which supplies the plough, in accordance with recent Italian practice. The merits of rotary tillers were discussed.

The Public Works and Transport Congress.

No. III. (*Conclusion*).*

AT the afternoon session on Thursday, November 17th, there were two series of Conferences, the first being held under the auspices of the British Waterworks Association. To it three papers were presented :—(*a*) "Water Divining," by Professor J. W. Gregory, F.R.S., of Glasgow University ; (*b*) "The Economics of Water Supply," by Mr. F. J. Alban, accountant to the Taf Fechan Water Supply Board ; and (*c*) "Rural Water Supplies—The Advantages of Decentralisation," by Mr. D. F. Worger, late Southern District Engineer to the Metropolitan Water Board.

Dr. Gregory's paper contains an interesting and impartial account of the history and practice of "dowsing," without giving any decided opinion one way or the other as to its practical efficacy.

Mr. Alban's paper, which is to a considerable extent statistical, is divided under the following headings :—(*a*) "The Capital and Annual Costs of Water Supply ;" (*b*) "The Incidence of the Annual Cost between the Ratepayer and the Water Consumer ;" (*c*) "The Incidence of the Annual Cost as between Water Consumers *inter se* ;" and (*d*) "Methods of Collecting Water Charges."

Mr. Worger's paper is largely concerned with the operation of a particular system of auto-pneumatic water supply.

The second series of Conferences on this afternoon had been arranged by the Association of Managers of Sewage Disposal Works. There were two papers : (*a*) "Small Sewage Works," by Mr. J. H. Garner, Deputy Chief Inspector of the West Riding Rivers Board ; and (*b*) "First Principles in Sewage Disposal," by Mr. F. C. Temple, M. Inst. C.E., Chief Town Engineer and Administrator to the Tata Iron and Steel Company.

In his paper Mr. Garner remarked that a number of factors had during recent years combined to bring into greater prominence the various problems associated with the purification of sewage in small installations, and, speaking generally, the prevailing conditions throughout the country had tended—and still tended—towards increasing the number of comparatively small sewage works.

Among the factors contributing to those conditions might be mentioned, first of all, building developments in connection with municipal housing and town-planning schemes ; together with private building enterprise, which had gradually converted many rural hamlets and villages into residential districts. Secondly, new communities and in some cases entirely new villages had sprung up, consequent upon industrial developments, such as the opening of new collieries and factories, in what were formerly sparesly populated areas. In fact, some districts had been transformed from agricultural to thickly populated villages, until the work of administration had become altogether too unwieldy for a single Rural Council. Thirdly, the very commendable desire for improved sanitary arrangements, such as hot and cold water services, baths and water-closets, had resulted in an increasing number of the older houses in rural and suburban districts being fitted with those conveniences.

It might be said, therefore, that the volume of sewage per head of population was increasing, and that problems of sewage purification were becoming more widespread The extent to which those problems had been considered in connection with the changes previously mentioned showed a wide variation, as might be expected from the diversity of local conditions—financial and otherwise. On the one hand, purification works had been extended or new works constructed in anticipation of the sewage to be dealt with ; on the other hand, the building of houses with separate cesspools had proceeded until the number became so large that emptying constituted a nuisance, and the annual cost approximated to the interest and sinking fund charges upon plant for dealing effectively with the sewage of the area concerned.

In his paper the author said he intended to deal with the subject from the point of view of the sewage works manager, and the headings under which he treated his subject were :—(*a*) "Settlement and Surface Irrigation ;" (*b*) "Settlement and Land Filtration ;" (*c*) "The Design and Capacity of Small Septic Tanks ;" (*d*) "Continuous Flow Settling Tanks ;" (*e*) "Percolating Filters ;" (*f*) "Automatic Dosing Apparatus ;" (*g*) "Methods of Distribution ;" (*h*) "Humus Tanks and Straining Filters ;" (*i*) "Storm Water Treatment ;" (*j*) "Sludge Disposal ;" and (*k*) "Control and Management."

Mr. Temple began his paper by remarking that the science of sewage disposal was still seriously hampered by the natural difficulty, to which every science must inevitaby be subject, of discriminating between the essential and the incidental functions of its various processes and appliances, and of finding a vocabulary in which those functions might be described with precision. The vocabulary which had attached itself to sewage disposal was, he said, unfortunately, singularly loose and unscientific. For instance, sewages were still spoken of as strong, average or weak, though the following table of the connotation of those terms in different countries showed how little precise information they conveyed :—

	Strong. Gals. per head.	Average. Gals per head.	Weak. Gals per head.
India	5 to 15 ..	15 to 30 ..	30 and upwards
England ..	15 to 25 ..	25 to 40 ..	40 ,,
America ..	40 to 70 ..	70 to 100 ..	100 ,,

Then, again, grit catchers, grit chambers or detritus tanks, as they were called, with apparent indifference, were proportioned vaguely to the total dry-weather flow. Septic tanks were frequently discussed in terms of rate of flow of the sewage through the tanks. The capacity of storm water tanks was almost always given in terms of the total average dry-weather flow. Activated sludge systems were usually dicsussed in terms of aeration of the total daily flow. Filters, again, were still frequently discussed in terms of gallons of liquid per acre of surface of filtering material irrespective of the strength of the sewage or the depth of the filter.

It was interesting but unprofitable to trace and discuss the way in which that loose nomenclature had grown. Its main faults lay, first, in the tacit ignoring of the fact that of the water in the sewage only a very small part was essential to the sewage while the remainder was partly a vehicle and partly a fortuitous adulteration ; and, secondly, in the failure to distinguish explicitly between the mechanical functions on the one hand, and the chemical and biological functions on the other of the various apparatus used in sewage disposal.

In designing a sewage works it was of supreme importance to keep clearly in mind the distinction between the mechanical and physiological processes. . . . . Sewage disposal works should be discussed like any other apparatus in terms of the work to be done. That for the grit catchers, settling tanks, if any, and storm water tanks was in terms of velocities and quality of material to be extracted, and for biological treatment apparatus in terms of the number of users. Clear and precise thought and speech on lines such as those would tend to disclose and emphasise the basic principles which underlay many apparently discrepant phenomena, and would do more than anything else to advance the science of sewage disposal.

On the Friday morning there were conferences under the auspices of the Institution of Municipal and County Engineers, at which the following papers were considered :—(*a*) "Present-day Implications of Local Ownership and Transport Undertakings," by Mr. H. Marsh, of the clerical staff of the Great Western Railway, and (*b*) "Costing for Public Works and Buildings," by Mr. B. Price Davies, Surveyor of Works to the Cardiff City Council.

Mr. Marsh began his paper by remarking that it would be idle to attempt to justify local ownership of transport undertakings, such as tramways or light railways, on the grounds of the inadequacy or proven unfitness of private individuals to conduct them. None the less, there was no doubt as to the fundamental social importance of enterprises of the kind. To go further, there existed, in effect, a sufficiently widespread common interest and public importance to warrant their assumption by local authorities. It could anyway be affirmed at the outset that in those enterprises—for all practical purposes—free competition was inapplicable. The only choice was between a public monopoly and a private monopoly under social regulation.

In concluding his paper, he said that on the basis of the remarks he had made, the main conclusions which suggested themselves might be summarised as follows :—

(*a*) The general policy of local authorities in the conduct of transport, and, for that matter, other "public utility" concerns, should be devised to safeguard the social interests of the community, the needs of the treasury, and the legitimate demands of the employees. Further, a close concentration of study should be given by the responsible officers to the advancement of the technical efficiency of their undertakings.

(*b*) As to tramway undertakings, local conditions in a great many cases were not such as to warrant their abandonment. On the contrary, there were good grounds for believing that a satisfactory substitute had not been found for handling great densities of traffic.

(*c*) The trackless trolley vehicle was a useful half-way plan, where an eventual change-over to motor omnibuses was contemplated, but was at best a temporary expedient.

(*d*) The motor omnibus had indubitably come to stay, but it was suggested that its primary function was not—as appeared to be the impression in some quarters—to handle the dense traffic of the trunk roads, but rather to operate in outlying districts where no trams existed.

(*e*) The line of real advance in connection with passenger road transport appeared to lie in the co-ordination of both municipally and privately owned services, with the dual object of eliminating competition and securing improved facilities.

(*f*) Local authorities which were engaged in town or regional planning schemes should give the fullest attention to the question of the present and future transport needs of the population to be expected in the areas under development.

Mr. Price Davies' paper on costing is a most elaborate document, which had entailed a large amount of labour in its preparation. Largely, it is explanatory of a system which would make for the standardisation of costing of municipal departments. As such it has comparatively small interest for engineers, and we do not, therefore, propose to deal with it further.

For the afternoon session the conferences had again been arranged by the Institution of Municipal and County Engineers. There were two papers, both dealing with protection against encroachment by the sea.

The first, which was by Mr. E. J. McKaig, Assoc. M. Inst. C.E., Consulting Engineer of Cardiff, was entitled "Coast Erosion and Defence." It is an exceedingly interesting dissertation on the subject, and is profusely illustrated by means of well-executed and informative sketches. It would not be possible to convey a really clear impression of it by making an abstract, and we must confine ourselves to giving the headings under which the matter is dealt with. We may state, too, that the author himself says at the outset that the view taken in the paper is a general rather than a particular one, with the object of considering and defining the fundamentals of the subject. After dealing with foreshore, tidal currents, &c., the author goes on to discuss, in turn, (*a*) Tidal Waves ; (*b*) Undertow ; (*c*) Littoral Drift and Zone ; (*d*) Groynes ; (*e*) Brushwood Groynes ; (*f*) Experimental Works ; (*g*) Stockades ; (*h*) Concrete ; and (*i*) Finance.

The second paper was entitled "Sea Defence : Erosion and Protection on a Sandy Coast," and was by Mr. S. W. Mobbs, Borough Engineer of Lowestoft. The author begins by saying that his paper is an account of failures, experiment and recent successful work in a district with a sand and shingle beach, and a very unstable and easily eroded foundation, consisting mainly of water-logged sand and shingle, with, in some cases, thin layers of loamy clay. Within recent years, he said, no portion of the British coast, except the Holderness district of Yorkshire, had suffered more from erosion than the coast of Norfolk and North Suffolk. The tendency there was for the coast, forming as it did a salient, to be gradually eroded ; the littoral drift was from north to south, and material moved found its way towards the Thames Estuary. Erosion did not progress at a regular rate, and the tendency was for the coast as a whole to gain slightly during the summer months and to lose during the winter months. A "mild" winter might mean little loss of material, or even slight gain, but, over a period, the balance was considerably on the wrong side.

The author then proceeded to discuss in order :—"General Configuration of Coast ;" "Effect of Harbour Projection ;" "Early Works of Sea Defence ;" "Failure of Early Works ;" "Characteristics of Local Erosion ;" "Increase of Wave Action ;" "Formation and Denudation of Beaches ;" "Measures to Combat 'Vertical Erosion' and other Temporary Measures." He then went on to say that he had come to the conclusion that the best way of combating vertical erosion was to design a very low wall as near to the contour of a natural beach as possible, thus allowing seas to "spend" and the backwash to drop back on the beach as gently as possible, with provision at the rear for preventing flooding, and for preventing undermining during local severe scour by means of sheet piling. On the assumption that no form of wall could actually collect material, the function of the wall was to preserve, so to speak, the *status quo* during gales, to prevent flooding and act as a base to the groynes.

He also gave illustrations showing the section of the sea walls as proposed, and as finally constructed, and explained that the groyning was designed with a view to inducing the "depositing" currents to deflect shorewards, to keep the sea-ends as low as possible, to prevent tidal "scour" past the ends, to present as little vertical area as possible to wave action, and to allow regular feed of material along the whole beach over the tops of the groynes. That principle varied somewhat from the usual theory of groyning. The first groynes put in were of pitch pine timber. The author, however, developed and patented a new type of reinforced groyne, which he also illustrated, and he set out the claims that he made for it.

In conclusion, Mr. Mobbs said that three years' experience had shown that, so far as could be judged—though he was far from claiming that absolute finality had been reached—the general design of the works appeared to have been correct. The groynes had thrown back high water mark so far that, whereas on the completion of the works 27 acres of foreshore existed in front of the line of wall, to-day the area was 36 acres. It was noticeable that severity of general "scour" during unfavourable winds had been greatly decreased ; the beach was evenly distributed, and the checking of excessive holding up and seaward deflection of drift had resulted in greatly improved beaches, not only in the neighbourhood of the works, but for a length of 2½ miles further south. That good result was expected to be accentuated when certain portions of the old walls and groynes,

* No. II. appeared November 25th.

still standing and which were having a detrimental effect, were demolished. The old walls were being blown down by gelignite to about half tide level, and the old groynes, which had been weakened by unbolting and removing as much timber as possible, were gradually being destroyed by sea action.

On Friday afternoon there was also a conference arranged by the National "Safety First" Association, and the paper before it was "A Review of Road Accidents: Frequency, Cause, and Prevention." It was presented by Lieut.-Colonel J. A. A. Pickard, D.S.O., the general secretary of the Association. The paper was divided into three parts—I., "Accident Frequency;" II., "Accident Causation;" and III., Remedies. A summary of the remedies suggested is as follows:—(A) General administrative: (1) Research into accident causation; (2) extension of educative campaign on lines of road fellowship; (3) formation of local Safety Councils; (4) issue of regulations for the safety of traffic at road junctions; and (5) issue of regulations for the lighting of vehicles. (B) Motor driver, including horse vehicle driver so far as applicable: (1) Declaration as to knowledge of rules of road before issue of licence; (2) special mobile traffic police to suppress genuine dangerous driving, in particular (*a*) speeding, (*b*) failure to keep to near side of road (all traffic), (*c*) carelessness at road junctions (all traffic), and (*d*) improper overtaking (all traffic); (3) extension of educative propaganda. (C) Pedestrians and cyclists: Extension of educative propaganda, particularly in schools. (D) Motor vehicles, other than public service vehicles which are specially supervised: Declaration of mechanical fitness when re-licensed. (E) Road: (1) Provision of properly surfaced footways for pedestrians, or, failing this (2) provision of specially marked off passage on carriageway for pedestrians, where no footway exists; (3) provision of more refuges and defined crossing places; (4) edges of carriageway to be kept in good condition; (5) tramlines kept in better repair; (6) improvements to range of vision; (7) standardisation of siting of road signs; and (8) uniform standard of good lighting of streets and obstructions.

On the final day of the Congress the conferences were in charge of the Institute of Cleansing Superintendents. Two papers were considered. The first was entitled "Cleansing," and was by Mr. W. Weaver, the Chief Chemist of the Birmingham Corporation Salvage Department.

The author began by saying that from time remote, cleansing, and all that the word implied had been regarded as the most menial of occupations, and dependent for its performance on the most lowly stationed of civilised humanity; yet it was an interesting reflection that the most powerful lord in his castle depended for his well-being and even his life on the observance of that duty by his humblest vassals; and wherever the human race had congregated in a great community, that vast body of living beings was likewise dependent for its health and its *joie de vivre* on the efforts of those whose duty it was to maintain the community in a sanitary and hygienic condition. When the lord was all powerful in his castle, conditions of life were vastly simpler than they were to-day, and the simplest of scullions could no doubt be trusted with the duty of maintaining a certain degree of cleanliness which satisfied the canons of hygiene; but to-day, with our more involved methods of existence, a great city could not allow what had justly become recognised as a matter of vital importance, its sanitary condition, to rest in the hands of the "unlettered and unread." Yet tradition died hard; a revised version of the practices of yesterday still remained with us in some towns, and a very few years ago one could remember that the cleansing department was the Cinderella of corporate life, and her sister activities looked down on her with good-natured contempt and toleration as something which was more or less necessary, but worthy of scant consideration. Times were changing, however, and in progressive towns the results of education and the activities of virile and able Cleansing Superintendents were gradually elevating the status of the cleansing department to one of primary importance; and the maintenance of sanitary conditions in our great cities was a question which was constantly cropping up at the meetings of various learned bodies.

The subject was dealt with in the paper under the following headings:—"Causes of High Yield of House Refuse;" "Variation in Yield of House Refuse;" "Composition of House Refuse;" "Combating the High House-refuse Yield;" "Home Destruction—Incentive;" "Bin Capacity;" "The Dustman's Co-operation;" "Propaganda Work;" "Collection of House Refuse;" "The Electric Vehicle;" "Methods of Dealing with House Refuse;" and "Clinker."

In concluding, the author suggested that sufficient advantage was not at present taken at destructor stations of such scientific instruments as waterflow and CO_2 recorders, temperature indicators, &c.

The final paper before the Congress was by Mr. Alex. L. Thomson, the Chief Sanitary Inspector, Inspector of Cleansing and Sewage Works Manager of Motherwell, and it discussed "Why the Yield of House Refuse is Unnecessarily High and How it May be Reduced."

All that need be given concerning this paper are the conclusions at which the author arrives. They are as follows:—

(*a*) There is an excessive production of domestic refuse because of thoughtlessness in regard to the matter.

(*b*) The housewife must be educated to produce less. Every means of achieving that must be properly, not blindly, employed.

(*c*) The management and supervision of collection must be such that wanton bin-filling is discouraged and only unavoidable residues and rejects require the scavenger's call.

(*d*) There should be co-operative effort between authorities regarding publicity activity, so that the best service may be secured. Slides, films and exhibits, posters, leaflets and other help and information should be centrally obtainable on easy terms of hire.

(*e*) The advisability of the information of a Publicity Council should be considered.

The conference was attended by some 2000 delegates from at home and abroad.

Emergency Bilge Pumping Arrangements.

IN view of the interest which was recently aroused by a correspondence on bilge pumping arrangements in colliers and other ships, in the columns of our esteemed contemporary, the *Journal of Commerce*, we are pleased to describe a simple pipe arrangement which was invented some time ago by Mr. Sterry B. Freeman, the superintendent engineer of Alfred Holt and Co., and is in successful use on Holt Line vessels.

It is only when one has stood on the deck of a ship with the knowledge that water is gaining in the hold under one's feet, and that nothing can be done to restore the pumps to action, that the need of some emergency device is really felt. The pipe arrangement suggested by Mr. Freeman is a very simple one, and it has the great merit of being inexpensive, so that it can form a cheap and convenient addition to the ordinary arrangement of bilge piping. It will be seen from our illustrations that the essential principle consists in arranging for successive suctions to come into action at progressively higher levels as the depth of water in the hold increases. We show in Figs. 1 and 2 two possible arrangements, but others

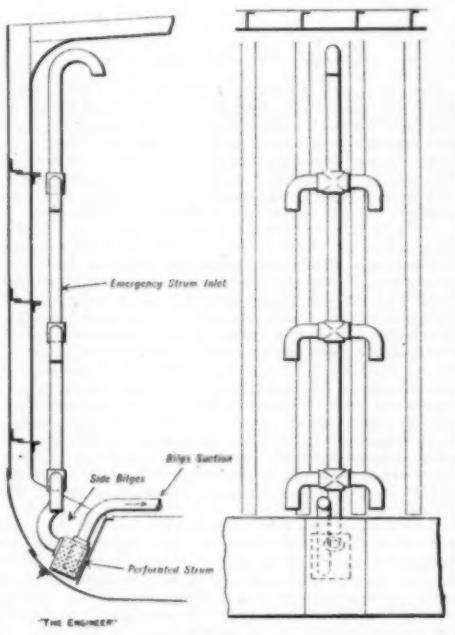


FIG. 1

will suggest themselves for different lay-outs of pumps and piping, the idea being one which can be adapted to meet the special conditions without having to sacrifice any essential principles or alter in any way the lay-out of pumps and piping.

On the strum or rose box it will be seen that an additional inlet pipe is fixed rising to a convenient height, preferably to the underside of the deck, as in Fig. 1 This pipe may be of the same area as the bilge suction pipe inside the strum. At convenient intervals, say, 2ft. apart, pairs of short branch pipes are welded or otherwise connected to the auxiliary pipe, and the short branch pipes are turned downwards, about 2in. When solid matter is washed down round the strum, and the holes become choked, no water can reach the end of the bilge suction pipe inside the strum, and the pumps cease to draw. Water then rises in the bilge until it reaches the down turned branches on the auxiliary pipe. As the auxiliary pipe is open to the atmosphere, there is no suction at the mouth of these branches to draw floating *débris* in. Having risen above the mouth of the branches, the water then pours down each branch into the auxiliary pipe and again seals the end of the bilge suction pipe inside the strum. The pumps in the engine-room can now suck again and pumping is automatically continued. If the water rising in the hold carries the level of the solids up to the first branch pieces the water will cease to flow to the strum, but the solids will not flow up hill in the branch pipes. Nothing happens until the rising water reaches and pours down the next pair of branches, and so on. The illustrations—Figs. 1 and 2—show how the pipes may be fitted. If the vertical pipe has a straight lead to the deck it can conveniently be used as the sounding pipe to the bilges—as shown in Fig. 2—in which case the sounding rod bottoms on the inside of the strum box.

It is not claimed that this system will prevent disaster if the ship's side is opened or the bottom pierced to such an extent that the pumps fitted in the engine-room cannot cope with the incoming water, and the emergency strum inlet pipe has nothing to do with the size or type of pumps which are fitted; for obviously the bigger the pumps fitted in the engine-room the safer the ship. The point is that, however big the pumps in the engine-room may be, unless the water has access to them it cannot be discharged, and this system provides that access. Again, if the bilge strum provided in the ordinary lay-out admits foreign matter to such an extent that the pipe between the strum and the pump becomes choked, the impact of a fresh stream of clear water from above striking upon an accumulation of dirt at the mouth of the pipe inside the strum helps to loosen and disperse the stoppage. What is claimed for the system is that it is a palliative; it permits pumping to go on for an indefinite length of time after the original

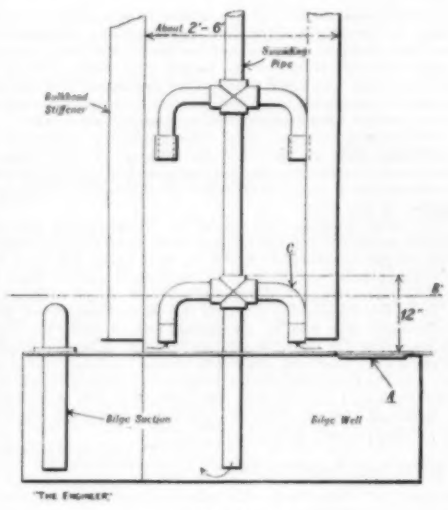


FIG. 2

strum is embedded in a mass of dirt or cargo which may have been washed down upon it, and will enable the pumps to discharge overboard as much water as the area of the pipes provided will discharge to the strum in question.

One has only to examine carefully the hold limbers of the average ship to realise how this question of emergency bilge pumping has obviously puzzled nautical people for years past. Cement chocks are fitted between the frames, limber boards are fitted as closely as possible from the ship's side to the tank top, and then are chintzed (*i.e.*, caulked with a single thread of oakum) and on some occasions are even caulked and payed, to keep solids out of the bilges. If this treatment were successful it would, of course, equally keep water out. Occasionally holes are bored in the limber boards to allow the water to go down, with the inevitable result that solid matter goes with the water. It should not be forgotten that the average pump will deal with a certain amount of solid matter mixed with the water, and experience has shown that the holes provided in the strum boxes do not admit solids of too large a size to be dealt with. The mud box in the engine-room comes into play to safeguard the bilge suction valves, plungers and discharge valves, but all these fittings are unaffected by the addition of successive suctions in the holds.

It has been urged that the fitting of a trunkway from the deck to the bottom of each hold should be made compulsory, and schemes have been produced in which it has been combined with the ventilating system, ladders being fixed inside the ventilators, which should serve the double purpose of ventilation and access to the bottom of the ship. The bilge pumping system we have illustrated does not in any way conflict with such schemes, but it will be readily admitted that it is a very much cheaper expedient, and, after all, cheapness will be one of the factors which will determine whether anything is done at all or not. It might very well be the case that on arrival at the bottom of such a ladder the water might be found washing over the tank top, in which case the emergency strum inlet system would be gratefully welcomed as ensuring a minimum of bilge diving before the strum was reached and cleared.

CANADIAN STEEL CASTINGS.—Canadian magnetite or refractory iron ores are to be used in the manufacture of steel in the Dominion of Canada. The Carbon and Alloys Steel Company, recently formed, has taken over the plant at Welland, Ontario, formerly occupied by the Electric Steel and Metal Company, and the Electric Steel and Engineering Company, and is reopening the foundry for production of steel castings from Canadian ore. The Welland plant is equipped with two 6-ton Héroult electric furnaces, and with a main building 400ft. long and 83ft. wide. The ores to be used in the plant are mined in Quebec, not far from Montreal. Analyses indicate a metallic content of 72 per cent., with 37 per cent. titanic acid. The process employed requires that they be first passed through rotating roasters into which is forced a charge of special gas. This, it is claimed, changes the molecular structure of the ore, making it immediately adaptable to foundry use.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

RECENT BRITISH LOCOMOTIVES.

SIR,—Further to my letter of October 7th last on the same subject, I am sorry that I am not authorised by the Italian State Railways to publish the results of the comparative running between the saturated engines and their superheated single similar types.

However, the economy in coal consumption was one of the reasons for adopting superheating and relinquishing compounding. Now there are in service in Italy the following numbers of engines of the following groups :—

	Axle arrangement.	Group.	Number.	
A	2–6–0 ..	600 ..	248 ..	2-cyl., compound
	2–6–0 ..	625 ..	188 ..	2-cyl., superheated
B	2–6–0 ..	630 ..	100 ..	2-cyl., compound
	2–6–0 ..	640 ..	169 ..	2-cyl., superheated
C	2–6–2 ..	680 ..	150 ..	4-cyl., compound
	2–6–2 ..	685 ..	301 ..	4-cyl., superheated
D	2–8–0 ..	730 ..	190 ..	2-cyl., compound
	2–8–0 ..	740		
		and 735 ..	856 ..	2-cyl., superheated
			2202	

These groups are two by two similar to each other in everything, except the fitting of the superheater, the cylinders and the boiler pressure, which is between 200 lb. and 228 lb. for the compounds and 170 lb. for the superheated singles. The total number of the compounds is 688 and of the singles 1514, and the results of convenience in use and economy in running and repairs of this total of 2202 locomotives is certainly a safe average.

Furthermore, the fact that these groups are scattered all over Italy—that is, that they are working on very different lines, some completely on the flat and some in very hilly country—ensures that no unfair advantage is given to compounds against singles, or *vice versa*.

The State Railways have come to the conclusion that the simple superheated engines are preferable. They are now building only simple superheated engines of these types, and they are transforming the compounds into superheated engines when by repairs and renewing of cylinders or boilers it is made convenient.

As to the distributing gear, all the engines considered have Walschaerts gear, and the compounds had originally two independent gears for the high-pressure and low-pressure cylinders. It has always been very difficult to obtain intelligent use of the two gears by the engine-drivers, and having repaired a number of these engines, I can say that generally the frames showed distortions and irregular wear, owing to too much work being done by the low-pressure cylinder.

V. PECORI GIRALDI.

Milan, Italy, November 28th.

SIR,—There is in the employ of every British railway an engineer charged with the duty of providing locomotives capable of working trains safely, punctually and economically. These gentlemen, governed by practical experience, refuse to introduce compound engines on a wholesale scale, and therefore Mr. Charles R. King has now arrived at the extraordinary presumption that British locomotives should be designed in accordance with the obsessions of theorists who glibly quote thermal efficiencies of 13 per cent.

In view of Mr. King's extensive familiarity with continental locomotive practice, one is tempted to ask if he has ever read Professor Sauvage's statement that "economy in locomotive working does not mean only economy on the coal bill, but on the total expenses of locomotive service." The above stated fact, well known to all who are in any way connected with the practical working of railway traffic by means of locomotive engines, is ignored by visionary theorists and thermal-efficiency experts. These latter gentlemen never consider the lower capital and maintenance costs and the greater reliability of the simple locomotive.

Given two locomotives equally reliable, available and suitable to perform a given work, that engine will be the more economical which will deliver a horse-power, not in the cylinders, but at the tender drawhook, at the lower total cost. In his comparison of the Great Western "Castle" class and the P.L.M. 4–6–2 engine No. 6204, Mr. King carefully refrains from stating that the Great Western engine, operating over more severe gradients, delivered 74 per cent. of its indicated power at the tender drawhook, while the corresponding figure for the P.L.M. engine was but 65 per cent.

Mr. King no doubt knows that his continental friends are far from being united in their opinions on the subject of compounding. He is possibly familiar with recent two-cylinder simple locomotives on the Paris-Orleans and Midi Railways, of France. While he refers repeatedly to the tests conducted by the Italian State Railways in 1908–9, he is apparently unaware of the experimental runs made with 2–6–2 and 4–6–2 superheated locomotives on the same railways in 1910–11, and I respectfully suggest that the results of these latter tests may be of interest to him, though they certainly will not confirm the erroneous impressions which he now possesses. Does Mr. King know that the Italian Railways have recently constructed a number of 2–10–0 two-cylinder simple superheated goods engines? Is he aware of the attitude toward compounds now exhibited in Austria, Poland, Hungary and Czecho-Slovakia? Can he say how many of the new standard types designed by the Deutsche Reichsbahn Gesellschaft will have compound cylinders?

Let the advocates of compounding ponder the foregoing questions, and they will be forced to admit, reluctantly of course, that compound locomotives do not at present occupy a secure position on the Continent of Europe.

By continually reiterating the absurd statement that a partial regulator opening combined with long cut-off is more economical than a full regulator opening with shorter cut-off, Mr. King is simply attempting to controvert well-known facts to suit his own peculiar view-point. I am well aware of his hostility toward what he contemptuously calls "bench tests" and "roller test plants," and consequently feel some hesitancy in referring him to anything that has been done on the Pennsylvania Railroad Company's plant at Altoona. But it may be that if he had a deeper knowledge of the work done on this plant he would have greater respect for it. I should like, therefore, to quote from "Locomotive Tests and Exhibits," page 725 :—

"Tests under partially opened throttle show that . . . the performance is less satisfactory than when carrying the same load with a full throttle and shorter cut-off."

The foregoing refers to the saturated steam engines used in 1904, and it has been fully confirmed by tests made on a 2–10–0 superheated locomotive in 1924.

Mr. King's comparison of indicator diagrams taken from one locomotive at 3 miles per hour and from another at 48 miles per hour is quite typical of his methods of argument. But I might mention that he discreetly omits to specify that the results of the P.L.M. tests are given in metric, not British, horse-power, and 2507 metric H.P. = 2472 British H.P. An I.H.P. of 2472 at 48 miles per hour is equivalent to a tractive force of about 19,300 lb. at that speed. To develop this effort in two 17·33in. by 25·59in. cylinders (with coupled wheels of 78·74in. diameter) would require a mean effective pressure of 198 lb. per square inch, or 26 lb. less than the impossible figure shown in Mr. King's diagram. This is a very good instance of the unreliability of the claims made by compound enthusiasts. Regardless of the protestations of Mr. King, the writer knows from experience that, unless equipped with complicated and costly intercepting valves, compound engines cannot start and accelerate a train as smoothly and rapidly as simple engines. Let Mr. King publish diagrams taken from a compound locomotive at starting and expose the wasteful process which occurs.

The statements made by Mr. King in his periodic diatribes against superheating would not be subscribed to by any responsible engineer. The position of superheating is too well established to require any defence at this late date, but I may be permitted to close by quoting the following words from the late Mr. C. J. Bowen Cooke :—

"Experience has undoubtedly proved that any saturated steam engine, re-designed only so far as necessary to convert it into a superheater engine, has extraordinarily different steaming qualities and capabilities for hauling heavy loads at high speeds."

This statement, made thirteen years ago, still agrees with the consensus of opinion among practical locomotive engineers.

Texas, November 14th. WM. T. HOECKER.

MERCURY BOILERS.

SIR,—The interest at present taken in mercury boilers prompts me to bring to your notice the following description of the steamship Columbus which appeared in the Catalogue of the Macpherson Collection of old Shipping Prints exhibited in the Whitechapel Art Gallery in 1924 :—

"70. Columbus. 325-ton paddler, built in 1838 for the purpose of testing Howard's quicksilver boiler, which contained the germ of some great ideas in the way of high pressure, and was given a trial in the Navy. It was maintained she could stow sufficient fuel for fifty days on the same draught that an ordinary steamer could stow for twelve. She cruised round the coast and maintained a speed of 10 miles an hour, burning 3 tons of mixed coal and anthracite per day. An explosion unfortunately led to the abandonment of the scheme of taking her across to New York. Col. aqua. 14½ by 22. Huggins-Rosenberg. 1837."

Is any more information available about Howard's quicksilver boiler? J. S. WILSON.

London, S.W 1.

THE MAN AND THE JOB.

SIR,—It is with the utmost diffidence that I take part in a discussion on a subject about which so much has already been said and written, tempting one merely to remark, *tot homines quot sententiæ*, and pass on to another matter. There is, however, so much food for thought in your leading article "The Man and the Job" that I suggest it should be reprinted and sent not only to every professor of engineering, but also to every employer who has at heart the welfare of his apprentices.

The policy of your journal is too well known for anyone to imagine that you would belittle scientific training for engineers, although you rightly emphasise the necessity for a sound foundation. If America is indeed "leaning towards methods of broadening the engineering intellect," she is assuredly on the high road to success, although those broadening influences may be subtle and difficult to define. I was particularly pleased to read your excellent advocacy of a "wide general knowledge" for the engineer, as I have long realised the necessity for this, and accordingly greatly deprecate such developments as special engineering sides in our public schools. I am convinced that a uniform school course, and a classical one at that—using the word "classical" in its widest application, for lack of a better term—is desirable for all boys; indeed, I would go further, and say essential. You rightly emphasise the need for imagination, and Mr. H. J. Kitchen aptly stresses personality, both of which are undoubtedly developed by the widest general education.

Too often engineers have to deplore the fact that they cannot meet their clients and others on equal terms, because of a conscious knowledge that there is something lacking in their general education. This is undoubtedly derogatory, not only to the profession to which they belong, but also to their individual jobs. They may be specialists, scientifically well trained, and yet be conscious of this subtle feeling of inferiority. Let us, then, seek to ensure that the engineer of the future shall not be thus handicapped.

"First-class B.O.T." introduces the question of remuneration, interesting in itself, but surely secondary in the present discussion. As a "commercial man" he is more successful financially than he was, but let him remember the words of the wisest man: "Better is a dry morsel and quietness therewith, than a house full of good cheer with strife" (Proverbs xvii. 1), and even if "First-class B.O.T." can now enjoy his plenitude of good cheer, the day may come when he will prefer the simpler fare, because it will be accompanied with the quietness that comes from the union of the Man and the Job in which he is happiest, where he has no longer to look regretfully backwards, as he says, "My heart is still in the profession."

G. W. TRIPP, A.C.G.I., M.I. Mech. E.

November 29th.

SIR,—In the discussion in your columns on the above subject a correspondent has raised the point "as to there being too many brains in the profession," and if I may be permitted to give my opinion I would say that it is not a question of too many engineering brains but a sad lack of brains of any kind in many of the company directorates; consequently we have the spectacle of British firms originally built up by able men going abroad for their designs. I am surprised that the ghosts of their predecessors do not rise up and chase them from the board room.

Directors will have to learn that the most able engineers and designers may not be those with the largest string of certificates or the longest string of letters attached to their name, nor yet with the greatest gift of eloquence. These may all be attained by men who have neither constructive nor administrative ability, but the average company director seldom understands these qualities when he meets them; consequently the spectacle I have alluded to.

No engineer despises technical education, but most of them know how little of the stuff they had to cram at the schools has been of any use to them. Many of them also have found out that the most valuable part of their education has gone in at their finger tips, and until this latter fact is again recognised, and acted upon, we shall never take the place in the engineering world that we once occupied.

Placing our industries in the hands of technically crammed inexperienced youths has landed us at the tip of the tail instead of the head of industrial progress. J. J.

London, W. 10.

LAUNCHES AND TRIAL TRIPS.

BEAVERHILL, twin-screw steamer; built by Barclay, Curle and Co., Ltd., to the order of the Canadian Pacific Railway Company; dimensions, 520ft. by 61ft. 6in. by 40ft. 6in.; 10,000 gross tonnage. Engines, twin-screw sets of single reduction geared turbines, pressure 250 lb.; constructed by the builders; launch, November 9th.

GLOCLIFFE, steamer; built by Craig, Taylor and Co., Ltd.; dimensions, 414ft. by 53ft. 6in. by 35ft. 6in. Engines, 25½in., 42in., 70in. diameter by 48in. stroke, pressure 180 lb.; constructed by Blair and Co., Ltd.; trial trip, November 9th.

BELPAMELA, cargo vessel; built by Sir W. G. Armstrong, Whitworth and Co., Ltd., to the order of A/S Rederiet Belmoira; dimensions, 340ft. 9in. by 49ft. by 23ft. 6in.; to carry 4325 tons. Engines, single-screw Armstrong-Sulzer Diesel, two-cycle type, 600 mm. diameter, 1060 mm. stroke; constructed by the builders; launch, November 10th.

EASTBOROUGH, steamer; built by Craig, Taylor and Co., Ltd., to the order of the Hazelwood Shipping Company, Ltd.; dimensions, 414ft. by 53ft. 6in. by 35ft. 6in. Engines, 25½in., 42in., 70in. diameter by 48in. stroke, pressure 180 lb.; constructed by Blair and Co., Ltd.; launch, November 10th.

PACHECO, motor cargo vessel; built by Harland and Wolff, Ltd., to the order of MacAndrews and Co., Ltd.; dimensions, 270ft. by 39ft. by 17ft. 6in.; 1375 gross tonnage. Engines, six-cylinder, single-acting Harland-B. and W. motor; constructed by the builders; launch, November 10th.

BRITISH UNION, oil tank motor ship; built by Swan, Hunter and Wigham-Richardson, Ltd., to the order of the British Tanker Co., Ltd.; dimensions, 454ft. by 57ft. beam; 10,000 tons deadweight. Engines, six-cylinder Wallsend-Sulzer oil; constructed by the Wallsend Slipway and Engineering Company, Ltd.; trial trip, November 15th.

ROCKPOOL, steamer; built by Wm. Gray and Co., Ltd., to the order of the Pool Shipping Company, Ltd.; dimensions, 418ft. by 53ft. 6in. by 29ft. 5½in. Engines, triple-expansion, 26in., 43in., and 71in. diameter by 48in. stroke; pressure, 180 lb.; constructed by the builders; trial trip, November 15th.

ZAHRA, steamer; built by Harland and Wolff, Ltd., to the order of the Vacuum Oil Company, Ltd.; dimensions, 180ft. by 33ft. 9in. by 14ft. Engines, inverted, direct-acting, triple-expansion; pressure, 180 lb.; constructed by D. and W. Henderson, Ltd.; trial trip, November 16th.

FERROCRETE, motor vessel; built by James Pollock, Sons and Co., Ltd., to the order of the Associated Portland Cement Manufacturers, Ltd.; 200 tons deadweight. Engines, 135–150 B.H.P. two-cylinder, direct reversible, heavy oil; constructed by the builders; trial trip, November 19th.

DUKE OF LANCASTER, twin-screw steamer; built by Wm. Denny and Bros., Ltd., to the order of the London, Midland and Scottish Railway Company; dimensions, 360ft. by 53ft. by 19ft. Engines, twin-screw single-reduction geared turbines; pressure, 225 lb.; constructed by the builders; launch, November 22nd.

PAULA, oil tanker; built by Harland and Wolff, Ltd., to the order of the Anglo-Saxon Petroleum Company, Ltd.; dimensions 305ft. by 50ft. by 15ft.; 2770 gross tonnage. Engines, two sets of single-acting, four-stroke cycle, six-cylinder motors; constructed by the builders; trial trip, November 22nd.

ZAHRA, oil tanker; built by Harland and Wolff, Ltd., to the order of the Vacuum Oil Company, Ltd.; dimensions, 180ft. by 33ft. 9in. by 14ft. Engines, triple-expansion, 16in., 26in., 42in. diameter, with 27in. stroke, pressure 180 lb.; constructed by the builders; handed to owners, November 22nd.

BUESTEN, oil tanker; built by Barclay, Curle and Co., Ltd., to the order of the Tonsberg Rederi Company, of Norway; dimensions, 400ft. by 52ft. 6in. by 29ft. 3in.; 8000 tons deadweight. Engines, single-screw oil; constructed by the builders; trial trip, November 23rd.

BEAVERBRAE, twin-screw steamer; built by Sir W. G. Armstrong, Whitworth and Co., Ltd., to the order of Canadian Pacific Steamships, Ltd.; dimensions, 495ft. by 61ft. 6in. by 40ft. 6in.; 10,500 tons deadweight. Engines, twin-screw, single reduction, geared turbines, pressure 250 lb.; constructed by the Parsons Marine Steam Turbine Company, Ltd.; launch, November 24th.

BOLFORD, motor tug and cargo barge; built by James Pollock Sons and Co., Ltd., to the order of the Associated Portland Cement Manufacturers, Ltd.; to carry 56 tons. Engines, two-cylinder, 90 B.H.P. Bolinder; constructed by the builders; trial trip, November 24th.

CHESAPEAKE, oil tank vessel; built by Workman, Clark and Co., Ltd., to the order of the Anglo-American Oil Company, Ltd.; dimensions, 470ft. by 63ft. 6in. by 34ft. 9in. Engines, eight-cylinder, single-acting, two-cycle Diesel; constructed by the builders; launch, November 24th.

KING JOHN, motor cargo vessel; built by Harland and Wolff, Ltd., to the order of the King Line, Ltd.; dimensions, 400ft. by 54ft. 6in. by 34ft. 8in.; 5180 gross tonnage. Engines, six-cylinder, four-cycle, single-acting Diesel; constructed by the builders; launch, November 24th.

NIMODA, single-screw steamer; built by Harland and Wolff, Ltd., to the order of the Hain Steamship Company, Ltd.; dimensions, 421ft. by 55ft. 9in. by 35ft. 9in.; 5000 gross tonnage. Engines, triple-expansion, 27in., 44in., and 73in. diameter with 48in. stroke, pressure 200 lb.; constructed by the builders; launch, November 24th.

PINTO, motor cargo vessel; built by Harland and Wolff, Ltd., to the order of MacAndrews and Co., Ltd.; dimensions, 270ft. by 39ft. by 17ft. 6in.; 1375 gross tonnage. Engines, six-cylinder single-acting, Harland-B. and W. motor; constructed by the builders; launch, November 24th.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Industrial Peace.

ANYTHING which may tend to assure for this country industrial peace has the whole-hearted support of Midland and Staffordshire manufacturers. They welcome the news that the General Council of the Trade Union Congress has accepted the invitation issued by a number of leading industrialists to attend a conference to discuss "matters relating to industrial peace and the strengthening of the competitive position of British industry." They hope both sides will recognise that the interests of employers and employed in industry are essentially the same, and that the most satisfactory results for each party can come better from co-operation than from antagonism. There is just a chance that this meeting may have momentous consequences, for if it is found possible to lay down a programme, the adoption of which individual industries will hardly be able to avoid, agreements which will prove of almost inestimable value to British industry may result.

Canal Bridges which Impede Industry.

One of the disabilities of industry and commerce, particularly in this part of the country, is the existence on important highways of weak bridges in the ownership of railway and canal companies. Transport by road is seriously impeded, and the restrictive notices recently placed on a large number of bridges by the undertakings responsible for their maintenance have made the matter one of importance. It is recognised that in many cases the bridges are inadequate to carry what has now become the normal traffic. The situation, as I have previously pointed out in these columns, is especially difficult in the Black Country, which is notably intersected by canals, and in which loads of 20 tons to 30 tons are nowadays regarded as matters of course. The real trouble is that the bridges cannot be improved, because neither the canal companies nor the local councils will find the tens of thousands necessary for their modernisation. In an endeavour to impress upon the Ministry of Transport the necessity of increased assistance from the Road Fund towards the reconstruction of these bridges, and of early legislation on the subject on the lines which have for some time been the subject of negotiations between the County Councils' Association, the Railway Companies' Association, and the Canal Companies' Association, a deputation representing Midland and other road authorities and industrial interests has waited on the Minister of Transport. The Minister undertook to "consider as sympathetically as possible" applications for assistance from the Road Fund in respect of "individual and urgent cases," adding that, "if general agreement could be reached on the lines which legislation should follow, he would do what he could to further the early introduction of the necessary measure." In view of this assurance it should be possible to proceed, at no very distant date, with the improvement of some, at least, of the structures the weakness of which is productive of real inconvenience.

Birmingham to the Sea.

Birmingham industrialists are largely interested in the proposal to bring under one management the canals connecting the Midlands and the sea, by way of London. A Bill is to be promoted in the next session of Parliament, the effect of which will be, if it is carried, to place the control of three local canal companies in the hands of the Regent's Canal and Dock Company. The undertakings affected are the Warwick and Birmingham Canal Company, the Warwick and Napton Canal Company, and the Warwick Junction Canal Company. Further, in the proposals which are made, the Regent's Canal and Dock Company will also acquire the Grand Junction Canal Company, so that the proposed extension will give it control of about 240 miles of waterways. This is probably the longest canal undertaking in the country under one control. The suggested acquisition of the Warwick and Birmingham group will give the Regent's Canal and Dock Company direct access to important industrial areas in the Midlands, the Birmingham district in turn, of course, being connected with the North of England by means of the Trent and Mersey and the Shropshire Canals. It will be possible for goods to be embarked in the centre of Birmingham—and proceed direct to the sea.

Future of the Electrical Industry.

If the optimistic views which were expressed at the annual dinner of the South Midland Centre of the Institution of Electrical Engineers, at Birmingham on the 26th ult., are anything to go by, a bright future is assured for the electrical industry. Mr. A. Page, President of the Institution, maintained that progress in regard to the supply of electricity to industry had been most satisfactory, and the prospects were very good. He thought they ought to accord to the manufacturing industry recognition for the fact that it had succeeded in the most marvellous way in ousting its continental and American competitors in the world's markets. "Our export trade on the electrical engineering side," he added, "is something to be really satisfied with, and to congratulate the manufacturers upon." Sir Ernest Rutherford, President of the Royal Society and director of the Cavendish Laboratory, said he thought anyone could foresee that within the next ten or twenty years there must be an enormous development in the application of electricity for a great variety of purposes throughout the land. Sir Hugo Hirst, chairman of the General Electric Company, Ltd., asserted that the electrical industry was acknowledged as the agent of nearly every social improvement that was contemplated.

Electrical Engineers' Contracts.

One Midland firm of electrical engineers, at any rate, can look to the future with confidence. The Electric Construction Company, Ltd., of Bushbury, Wolverhampton, has contracts on its books which are expected to keep it busy for the next fourteen months. They include, I learn, a complete plant for an electric rolling mill for a Glasgow firm. The motor is to be reversible and capable of developing 7500 brake horse-power at 50 revolutions per minute. In conjunction with it is a fly-wheel generator set, comprising mixed pressure turbine, tandem electric generators, a 30-ton fly-wheel, a 250 kW generator (supplying current to auxiliaries), and all the necessary control gear. For tin mines and dredging, partly in Borneo and partly in the Malay States, the company is to supply one 1000 kW, 150 revolutions per minute, three-phase fly-wheel type alternator for coupling to a Diesel engine; one 1000 kW 187 revolutions per minute three-phase fly-wheel type alternator for coupling to a Diesel engine, and four 300 kW three-phase alternators to be driven by crude-oil engines and to supply current to approximately forty electric motors, all of which form part of the contract. With the Swindon Corporation the company has concluded a contract to supply three 2000 kW rotary converters and two 500 kW rotary converters. Two 250 kW three-phase alternators running at 750 revolutions per minute are also to be supplied for gold mines at Fontino Bolivia, in South America.

Staffordshire Sugar Beet Factory Scheme.

At the request of prominent growers in the Staffordshire district, Sugar Industry Auxiliaries, Ltd., of London, has, I am given to understand, secured an option on a site for a sugar beet factory in Elford Parish, equidistant from Lichfield and Tamworth, in the centre of a rich agricultural area, which has already proved successful for sugar beet cultivation.

Derbyshire Pit Closed.

As a result of the serious depression in the coal trade J. and N. Nadin have closed down their pit at Newhall, South Derbyshire. This is the oldest colliery in the district, and at one time employed about 1000 men and boys. A small pit employing forty men will be continued to meet local demands.

Shropshire Blast-furnaces Damping Down.

Oakengates, an industrial centre of Shropshire, is suffering severely as a result of trade depression, and the announcement that the Lilleshall Company's blast-furnaces at Prinslee Works, near Shifnal, are being damped down this week has added to the existing depression.

Unemployment.

The returns showing the number unemployed in the Midlands record an increase this week of 4031, following a decrease last week of 3207 and an increase on the week before that of over 7000. In the Birmingham area there was a small decline, the figures falling from 26,664 to 26,577. At Coventry the position is much improved, the previous total of 5800 having been replaced by one of 4677.

Restricted Business.

At the weekly meeting of the Midland iron trade in Birmingham to-day—Thursday—business was slightly brighter, though buying remained of a restricted character. Foundry grades of pig iron were in better request, and the improvement in best grade finished iron was maintained. Steel business was decidedly quiet, especially in the structural branch. Values for the most part were easy. While some manufacturers report increased orders, others assert that contracts are being withheld, and that there is no real improvement in the situation

Finished Iron.

The demand for Staffordshire finished iron is poor. Makers of best grade iron for engineering and shipbuilding requirements are doing moderately well, and the price of marked bars is maintained at £13. Such sales as are effected in the Crown bar department are mainly for the heavier material Competition is increasingly keen with the Lancashire mills, which secure much of the export trade and more than a little of the local business. Values range from £9 10s. to £10 10s. The nut and bolt trades are working principally with foreign material, the relatively low price of which prevents Staffordshire makers from securing any appreciable share of this business. The industry, as a whole, is under a cloud, signs of the lifting of which are not yet in evidence.

Steel.

Though there are isolated instances of increased activity in the steel trade, the aggregate of business is not perceptibly greater, many mills being very short of orders. A somewhat hopeful feature is that structural inquiries are improving, and the plate mills are getting rather better demands in respect of shipbuilding. Steel masters maintain their quotations for angles and joists at £7 12s. 6d., and are willing to book orders for ship, bridge and tank plates at the minimum rate of £8 7s. 6d. Foreign joists are quoted at £4 10s. 6d. f.o.b. Antwerp, and are severely underselling local material. Staffordshire hoops do not vary in price, the basis of £10 10s. at works, which has stood for many months, being upheld. Staffordshire re-rollers are experiencing considerable competition for even small parcels of small bars and steel tube strip. Continental mills are quoting very low rates in an endeavour to secure the business. They have this week offered strip at £6 2s. 6d. per ton delivered Birmingham. Local re-rollers are quoting £7 12s. 6d. for small bars, while steel masters quote bars rolled from their own make of steel from £7 17s. 6d. to £9, according to quality and analysis. There is little call for billets either native or foreign, and values are unaltered.

Pig Iron.

Although a little more pig iron has been sold during the past week than of late, prices incline to weakness, and despite the fact that Midland smelters maintain their quotations, it is fairly certain that for substantial orders something less than the quoted prices would be accepted by many sellers. Restricted as the Midland output is, no difficulty is experienced in meeting demand. Indeed, stocks are reported to be accumulating, especially in Northamptonshire. The pipe foundries are busy, but in most other branches activity is lacking. Northamptonshire foundry iron is quoted at £3 0s. 6d. to £3 1s., and Derbyshire £3 5s. 6d. to £3 6s. at furnaces. East Coast hematite is quoted £4 8s. to £4 9s., and West Coast £4 10s. to £4 12s. 6d. delivered. A few parcels of hematite material from the North of England have been sold lately in this district.

Galvanised Sheets.

The demand for galvanised sheets is quiet, and the quotation for 24-gauge corrugateds has slipped back further, £13 5s. now being quoted. There is no renewal of buying in the export markets, and home demands are small. Many of the mills are unable to maintain output at the old level. It is a long time since the overseas markets were quite so dull. Light gauges are in fair inquiry.

Tin-plates.

The attempt to stabilise tin-plate prices in Birmingham has resulted in a little more movement in this branch of the market. Wasters have been in better demand in this district, and supplies are now less easy to obtain. Black plates also have been bought on more liberal lines by district manufacturers.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

£11,000,000 for Tube Railway.

IT is understood that the report of the Underground Railway Committee of the Manchester Corporation, which was set up nearly four years ago to consider the question of constructing an underground tube railway here, is shortly to be considered by the City Council. Briefly, the proposals of the Committee, which have already been referred to in this column, are for the construction in the first instance of an inner circle to serve the centre of the city and of five sections to serve the suburbs, the total length being 16¼ miles. The estimated cost of construction falls just short of £11,000,000, at an average cost of £669,592 per mile, including a double line. An interesting development during the past week has been the publication of what are reported to be the views of the city engineer concerning the proposal. They are in the following terms: "When the city of Manchester is fully built up the complete system of railways will be a success financially, but a complete system of railways would not be a financial success at the present time. Neither at the present time nor in the future would it pay to construct a branch radial line off the inner circle, owing to the expense of construction. The inner circle would require the revenue from the radial routes to support it." In a reference to the necessity of removing and reconstructing sewers, gas, water, electricity and telephone mains in the process of constructing the tubes, the Committee estimates the cost of street alterations at £89,600 per mile.

Constructional Contracts.

At a meeting of the Tramways Committee of the Manchester Corporation on Tuesday of this week two important contracts were decided upon in connection with structural extensions. With a view to building all its own tramcars, the Committee has decided to extend the principal depôt in Hyde-road where the constructional work is carried out. The cost will be £92,244, and the contract for the work has been placed with Messrs. Tinker and Young, Manchester. The Committee has placed the contract for steel work for a new motor omnibus garage, to be erected adjacent to the Queen's-road tram depôt, with Lambourne and Co., Ltd., of Openshaw, Manchester.

Non-ferrous Metals.

The tone of the various sections of the non-ferrous metal market may be described as steady to firm. Tin continues to display an improving tendency, although compared with the advance reported a week ago the prices current at the moment of writing, especially in the case of cash metal, are only fractionally higher on the week, the improvement in forward positions being somewhat more marked. The demand in this section of the market still leaves a good deal of room for improvement. There seems to be a widely expressed view of late that a marked expansion in the demand for tin from the Welsh tin-plate industry may shortly be looked for. The demand for copper for industrial purposes has been less active during the past week, and the probability is that consumers have recently purchased sufficient to cover their immediate needs. The demand for spelter has not been particularly strong, but the absence of weak sellers has again been a feature of this section, with the result that on balance quotations have been about maintained at the level that was current a week ago. In the case of lead, the consumptive position certainly appears to be brighter than it was several weeks ago, and it is not unlikely that the firmer appearance of the market of late has encouraged users to operate a little more freely. A further increase of 10s. a ton in the price of the metal has taken place since my last report.

Iron.

Easily the most interesting feature of the iron market here—really the only interesting feature—has been the lowering of the price of East Coast pig iron for delivery in Lancashire. Unfortunately for producers in that area, the half-a-crown reduction has not up to the present had any stimulating influence on sales here. Neither has it affected quotations in other sections of the

market for pig iron, although naturally such a move does not make for increased strength so far as other varieties of foundry iron are concerned. Altogether, conditions have been quiet from the point of view of new business, and apart from the booking of orders here and there for small quantities of the metal buying has been virtually at a standstill. Current quotations for delivery in the Manchester district are 78s. 6d. per ton for Middlesbrough No. 3, from 73s. to 73s. 6d. for Staffordshire, 73s. 6d. to 74s. for Derbyshire, from 88s. to 89s. for Scottish, and 85s. 6d. per ton for West Coast makes of hematite iron. There has been no change in the position of Lancashire bar iron, Crown quality still being quoted at £10 per ton and seconds at £9 10s., with the demand on a disappointing scale.

Steel.

Although there has been a moderate amount of day-to-day buying of domestic steel on this market, consumers are very much averse to venturing far ahead, even where contracts have expired, as they have in numerous cases. This, frankly, is due to an entire absence of confidence in the strength of the market. There is certainly weakness still to be observed in the case of steel bars, particularly in the small re-rolled sizes; although most sellers are asking £7 12s. 6d. per ton for these, down to £7 10s. is being quoted in other instances. Offers of boiler plates range from £10 5s. to £10 10s. per ton, whilst general plates and joists and sections remain at £8 7s. 6d. and £7 12s. 6d. per ton respectively. Rather more buying interest has been shown in certain varieties of imported steel, though "semis" continue very slow. For delivery to Lancashire works for cash against documents, steel bars are at £5 18s. per ton, sections at £5 12s. 6d., angles at £5 17s. 6d., wire rods at £6 8s. 6d., Thomas plates at £7 2s. 6d., Siemens plates at £7 10s. to £7 12s. 6d., and sheet bars at about £5 2s. 6d. per ton.

Fuel Economy in Small Installations.

A paper, entitled "Fuel Economy in Small Installations," was read at a meeting of the Manchester Association of Engineers, held on Friday, November 25th, by Mr. W. F. Rhodes, M.I. Mech. E. In the course of his paper the author gave his views on the choice of fuel, method of firing, flue gas analysis, pulverised coal firing, boiler settings and coverings, superheating, auxiliaries, economy in power production and running costs. He said that in recent years quite a number of Lancashire factories had installed entirely new plant, and in most instances it had proved far more economical to generate all the power required than to take the supply from an outside source. The charges for electric supply at the present time were often unreasonable, and in spite of all the efforts of the non-technical Press we were a long way from achieving the results in that direction which were so much desired. One of the drawbacks to taking a supply from an outside source was the fact that so often a "maximum demand" clause was inserted in the agreement. The inventor of that method of charging did a bad day's work for the cause of electricity supply in this country. The only reasonable way of charging was on a flat rate without undue restriction as to maximum demand. On the subject of pulverised fuel burning in Lancashire boilers, Mr. Rhodes referred to the difficulty in burning that kind of fuel in the restricted space available in that class of steam generator, but mentioned that that drawback was now being overcome by a turbulent effect produced by the newer burners which brought the necessary oxygen into contact with the carbon to be burnt and at the same time drove off the CO_2 which must be removed before further combustion could take place.

BARROW-IN-FURNESS.

Hematite.

There is no change in the condition of the hematite pig iron market, which remains dull, and, what is more, there are no signs of an improvement. There are only eleven furnaces in blast in the district, and a large proportion of the iron from those furnaces is being used by the local steel departments. There has been a certain amount of nibbling on the part of America, but it would appear that the prices offered are not very attractive to local makers. Customers are buying only for immediate requirements, and are not inclined to place orders for forward delivery. The iron ore trade is naturally a reflection of the iron market, inasmuch as very little ore is going outside the district. Several mines are idle, and perhaps the busiest in the district is the Florence Pit in Cumberland. The special furnace at Backbarrow is regularly at work, turning out a refined iron, and there are signs of this special branch of iron production being steadily improved.

Electricity Extensions.

It has been decided by the Barrow Electricity Committee, subject to confirmation by the Council, to place an order for a 7500-kilowatt plant in connection with the Corporation electricity works. In view of the fact that much of the work will be done locally, it is understood that Messrs. Vickers' tender, which is estimated at about £30,000, will be accepted, while the total cost of the extensions is estimated at £60,000. The Electricity Commissioners have given their sanction to the work going forward. The turbo-alternator will be manufactured by the Metropolitan-Vickers Company at Manchester.

A Notable Discharging Feat.

A notable discharging feat was recently accomplished at the Barrow docks by the L.M.S. Railway. The ss. Laguna, with 2000 tons of nitrate of soda, arrived at Barrow docks on the morning tide of a Thursday, was berthed at 12.30 p.m. the same day and commenced unloading at one o'clock; 993 tons of nitrate of soda were taken from the steamer on that day and 1007 tons on the Friday, the vessel leaving Barrow on the afternoon tide of the next day.

SHEFFIELD.

(From our own Correspondent.)

Heavy Steel Trade Dull.

CONDITIONS are extremely quiet in the iron and heavy steel trades, and there is little prospect of any improvement until the start of the New Year programme. Trade always slackens off about this period, and those with contracts to place prefer to wait until after the holidays. There may, therefore, be nothing more than a seasonal influence behind the present quietude. One certainly hopes not, for trade is in a very depressed state in several important branches. The production of steel from the open-hearth furnaces is down to a low point, and the influence is naturally also extending to the scrap and pig iron markets. A good deal of cutting in price quotations is proceeding in the effort to get business and to avoid the loss inevitable in curtailing production, but buyers prefer to follow the policy of purchasing just sufficient to cover their immediate urgent requirements, and in a good many cases this is being done by accepting delivery of foreign steel. In the semi-finished and finished branches of the heavy steel trade, the same dullness prevails. The rolling mills for rails, bars, strip and rods have short order books, and the foundries and forges could all accommodate a great deal more work. The Lincolnshire steel area is being similarly affected. It is possible to give a more favourable report in the case of the special steel lines. Good headway is being made with stainless steel developments, and much work is being turned out for the electrical and motor industries.

Cutlery and Plate.

The cutlery and plate industries are still full up with orders, but the ordinary rush of Christmas trade business has ceased. There will, of course, be the usual belated requests, and these and the orders on hand should keep the establishments in the city steadily employed up to Christmas. Cheaper lines have been popular this year, and some very attractive designs and cases have been brought out. It is believed that the season will prove a fairly good one, certainly better than last year when the purchasing power of the public had been so much decreased by the prolonged coal dispute. There has, too, been a good demand for silver ware, good-quality electro-plate and best stainless cutlery. It is reported that there has been an exceptionally good demand for stainless steel knives to be retailed at 6d. each. There seems to be a ready sale for them, and recently the appearance of these knives has been greatly improved.

Industrial Peace Move.

The attempt that is being made in Sheffield to overcome the troubles which from time to time confront the engineering and steel industries will be read of with interest by both employers and workmen in other centres. A new organisation, known as the Sheffield and District Engineering and Steel Trades Council, came into existence last week, and great hopes are placed in it. The employers in the initial move were represented by Mr. C. K. Everitt, of Edgar Allen and Co., Ltd., and Mr. M. R. Mainprice, of Brown, Bayley's Steel Works, Ltd., and the employees by Mr. W. Dodgson, Sheffield divisional secretary of the Iron and Steel Trades' Confederation, and Mr. R. E. Jones, Sheffield divisional secretary of the Amalgamated Engineers' Union. Mr. E. Hoult, the labour manager at Edgar Allen and Co., Ltd., has been appointed secretary of the new body. The objects of the organisation include the provision of facilities for personal intercourse between employers and workers, opportunities for general discussion, to carry out investigations, to study the conditions and problems affecting the working of the engineering and steel industries, and to formulate instructive proposals. The Council is unlimited in number, and is open to all sections of the engineering and steel industries, employers, trade union leaders, managers, foremen, draughtsmen, clerical staffs, and men from the workshops of any rank or status. The subscription is to be 5s. a year and may be paid by instalments. The Council does not intend to hamper, but rather to assist, the functioning of any of the existing machinery of discussion between employers and workers.

Deepest Electric Furnace.

A Sheffield firm of electro-metallurgists, Verdon Cutts and Co., Ltd., received news last week that one of its electric furnaces had been put into operation in a South African mine at a depth of 6300ft. This is claimed to be the greatest depth at which an electric furnace has ever been worked. This furnace has been installed for the heating of carbon drill steel, and is in furtherance of a movement for a more extensive heat treating of drills underground, instead of wasting time bringing them to the surface.

Goole Works Sold.

The machinery and plant of the Hook Shipyard at Goole, established by the Ouse Shipbuilding and Repairing Company, Ltd., has been sold to Thos. W. Ward and Co., Ltd., Sheffield, and the works are to be dismantled at an early date. The yard was established during the war and provided employment for several hundred shipyard workers. It ceased operations five years ago, and no use has been made of the plant since.

Colliery Matters.

Electric picks for heading purposes, cutting roads and getting coal are being used at the new Bilsthorpe Colliery of the Stanton Coal and Iron Company, Ltd., and it is believed that this is the first time the electric pick has been used in the Notts. coalfield. The Stanton Company is also adopting conveyors for intensifying production, and larger trams, with a carrying capacity of 24 cwt., will be used. If these experiments are successful, the output per man at the colliery will be considerably increased. Following the finding after much strenuous work of the lost seam of coal at Harworth Colliery, improved working there has been possible, and many additional miners have been signed on. It is hoped that the pit will be working at full strength before the end of the year.

NORTH OF ENGLAND.

(From our own Correspondent.)

Iron Selling Agency.

Two important steps have been taken by the Cleveland ironmasters this week. The more interesting is their decision to establish a central selling agency for their pig iron in Scotland, and the other is the adoption of a flat rate in future, irrespective of destination. For some considerable time past there has been apprehension among merchants regarding the more irksome restrictions which makers sought to impose, and also at the knowledge that the old paths of dealing through merchants were being neglected. More and more have manufacturers come to deal directly with users of both iron and steel, with consequent loss of business to the merchant. But no concerted action has been taken until this week. The establishment of the selling agency will, of course, practically eliminate the merchant, and bring about direct contact between manufacturer and consumer. The agency, the ironmasters claim, is designed to improve Cleveland's trade with Scotland, which has been on the decline for some years. If successful in this respect, the scheme will have much in the broad, general interest of Cleveland's industry to commend it, although the ironmasters' decision has naturally created concern among the merchants, who see their traditional sphere of business being eliminated. The ironmasters contend that the merchants might have been more active in the sale of Cleveland iron across the Tweed than some of them actually have been, but the merchants declare that they have done all they possibly could on the present basis of prices. The merchants are understood to be considering what is the most effective way to retort to the selling agency challenge. For two years past cheap continental pig iron has been handled by Cleveland merchants, and is being sold in fair quantities by them in the Scottish market. Thus the prospect of merchants offering continental iron in ever-increasing quantities in Scotland in competition with the iron offered by the new selling agency is full of piquancy.

Cheaper Pig Iron.

The abolition of the differential rates between iron offered for export and home consumption has been received with satisfaction by the principal consumers. In quoting 2s. 6d. per ton less to Scottish and foreign buyers than to English consumers, pig iron producers were influenced by the desire to recapture lost markets. But in this direction they have made little headway. Export trade is still very restricted, and Cleveland iron is not on a competitive level in Scotland. On the other hand, English consumers have been operating under a sense of irritation, which is not conducive to business confidence. After all, the home market is the biggest market, and as such should not be jeopardised. That view has at last prevailed, and English works can now buy Cleveland iron on the same terms as the Scottish or foreign consumers. It will probably lead to a cessation of the imports of foreign iron into the immediate district, and it should also materially broaden the area of distribution for Cleveland iron. Possibly, too, it will encourage consumers to place forward contracts, and if an expansion of output results, it will compensate the ironmasters for the sacrifices made.

Cleveland Iron Market.

Business generally is showing some expansion in the Cleveland pig iron trade, and the outlook is brighter and more encouraging. Local and other requirements are gradually growing, and, with the possibility of continental competition becoming rather less keen, hope is entertained that trading may be resumed with quarters from which this district has been excluded for some time by lower-priced commodities. The removal of the differential rates for home and export has already yielded a stimulus, orders for several thousand tons having been booked immediately the cut of half a crown was made, whilst there has been a steady flow of business and a further decrease in stocks to follow. Ironmasters now appear to have little to fear from foreign competition so far as the Tees-side area is concerned, prices of Cleveland iron being such as preclude continental firms securing repeat orders with founders here. Considerable deliveries against old contracts with firms abroad have, however, still to be made. No. 1 Cleveland foundry iron is 67s. 6d.; No. 3 G.M.B., 65s.; No. 4 foundry, 64s.; and No. 4 forge, 63s. 6d., both for home purposes and export.

Hematite Pig Iron.

East Coast hematite pig iron is selling rather better, and output is now little in excess of requirements. Recent substantial sales to South Wales, where there has been considerable use of continental hematite, is a gratifying feature. Fairly good business with Sheffield consumers has also been put through, and a few parcels have been disposed of for export overseas. Mixed numbers stand at 71s. 6d., and No. 1 quality at 72s.

Iron-making Materials.

Business in foreign ore continues on very quiet lines. Merchants, though making few sales, continue, however, to take a firm stand in the belief that heavy deliveries due next year to foreign buyers will assist to stiffen values. Best Rubio ore is quoted at 21s. per ton, c.i.f. Tees. Durham blast-furnace coke continues slow of sale. Market rates are based on good average kinds at 17s. 6d. per ton delivered at the works.

Manufactured Iron and Steel.

The works producing finished iron and steel are still actively employed, but an impression prevails that prices will have to be shaded before much new business

comes forward. The demand for galvanised corrugated sheets is very slow just now, and prices are easier at £13 7s. 6d. for sheets of 24 gauge and £10 for black sheets. All other prices are unaltered.

The Coal Trade.

There is no outstanding feature in the Northern coal trade. More business is badly needed to keep the pits working up to recent average, but in some sections the tone is brighter. So far as the best grades of steam coals are concerned, the prospects for December are satisfactory. There is a continued strong demand, and prices are easily upheld. Some collieries are better off for orders than they have been for some time, and if bad weather does not intervene, shipments should be very heavy during the next week or two. Direct best Blyth steams are firm at 14s. and at 13s. 6d. in second hands. Tyne primes and other qualities are unchanged, and steam smalls do not show any change in values. There is more inquiry for coking coals, but supplies are ample. Several substantial sales to the Continent have been effected by merchants, but prices obtained are stated to be on a low level. Holders, however, are holding firmly, and prices, according to grade, range from 13s. 3d. to 14s. 6d. Durham gas coal is in fairly good demand, but ample supplies hold prices on the easy side. Best qualities range from 15s. 6d. to 15s. 9d., and seconds from 13s. 6d. to 14s. There is not much new business in the coke market. Gas coke, although fully sold to the end of the year by makers, is offered in moderate volume through contractors, and values are just nominally steady at 24s. 6d. Foundry and patent cokes are plentiful at 17s. to 18s., but special makes still hold to 23s. to 25s. and beehive coke 25s. to 30s.

Ironworkers' Wages Fall.

Under the North of England Manufactured Iron Trade Sliding Scale, by which wages are regulated according to the average net selling price of manufactured iron, there will be a reduction of 2½ per cent. in the wages of puddlers and other forge and mill workers as from Monday last. The last wage adjustment took place in September, when there was a similar reduction of 2½ per cent.

SCOTLAND.

(From our own Correspondent.)

Moderate Activity.

THERE has been no real change in the industrial situation during the past week, and the best that can be said is that certain departments are moderately active, and that evidence of a partial revival in the shipbuilding industry has engendered a more hopeful feeling in the steel, iron, and allied trades. Latest advices from the Continent, too, seem to hold out some degree of hope that home prices may, at no distant date, be on a more competitive level, but this remains to be seen, as any upward trend of foreign prices may be only a temporary phase, and in any case the advance in the latter would require to be speedy if the home trade is to be beneficially affected within the near future. Meanwhile, the sheet iron and coal markets move along very quietly, and few concerns are able to see many days ahead.

Contracts.

One of the five cargo steamers, each of 10,000 tons deadweight, to be built for Messrs. Holden and Co., London, managers of the United British Steamship Company, Ltd., is to be built by the Fairfield Shipbuilding and Engineering Company, Govan. Further contracts for railway material have been placed, and, there is the important Government contract for the bridge over the river Benue in Nigeria, to be constructed and erected by Sir William Arrol and Co., Ltd., at a cost of practically £1,000,000.

Steel.

The demand for steel plates and sections is a shade better, and most of the works are engaged, but the total turnover is not large, and the existing depression is not appreciably lessened. Steel sheets have struck a quieter patch in the light gauges, and as heavy sheets have been comparatively inactive for some time, the outlook is unpromising. Home prices are unchanged, but export quotations are subject to considerable fluctuation.

Iron.

The iron market remains dull in practically all departments. Bar iron is in very restricted demand, and re-rolled steel bars are little better off, though occasionally preferred to the former owing to cheaper costs of the latter. Home prices are fixed, but export quotations are severely cut. Pig iron is stagnant. The curtailed output is still more than ample to meet all requirements, and though prices are unaltered on the week, the weakening tendency is still apparent. Foreign competition in all branches remains keen.

Exports and Imports.

Imports of iron ore totalled 13,000 tons during the past week, iron and steel including billets 2300 tons and pig iron 1100 tons from Calcutta. Exports of iron material totalled 6700 tons.

Coal.

There has been no important change in the coal trade. Lanarkshire splints maintain a firm level, Lanarkshire ells are comparatively steady, and steams in the Lothians and Fifeshire are fairly active, though first qualities in the last-named are not so well placed as other descriptions. Washed nuts in all districts are weakening. Aggregate shipments amounted to 242,650 tons, against 259,997 tons in the preceding week and 205,649 tons in the same week in 1925. Home demands for household and industrial use are not very heavy, and supplies are easily obtained. The cheaper grades of the former are mostly in favour.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

STEAM coal trade conditions have not materially altered within the past week, and unfortunately the depression which exists has to some extent spread to the anthracite section of the coalfield. The very mild winter being experienced is responsible for the falling off in the demand for coals, and in the case of the anthracite market, this has, of course, been substantially affected by the closing of the river St. Lawrence, and the suspension of shipments to Canada. Altogether, there is at the moment nothing to show that any improvement in trade will be seen this year, and, in fact, exporters are becoming resigned to the disappointing outlook. So far as next year is concerned, the prospect of business increasing is very nebulous, although hopes are entertained that South Wales will be able to recover some of the orders which went to coalfields abroad last year as the result of the national coal stoppage in this country. The most strenuous competition is, however, being encountered for all business that is coming along. In the case of the recent inquiry for 150,000 tons of patent fuel for the Algerian State Railways for delivery over 1928 it is reported that about 70,000 tons have come to this district, 30,000 tons have been placed for French fuel, and 50,000 tons have gone for Algerian fuel, while in the case of a separate inquiry for about 25,000 tons of sized coals, the order has been secured by Germany. Prices had to be in early this week for 60,000 tons of small coals for the Portuguese State Railways, and it is reported that this order has been placed with one of the leading Welsh undertakings. Tenders had to be in at Cairo on December 1st for 200,000 metric tons of large coals for the Egyptian State Railways for delivery over the first four months of next year. Prices have to be on a c.i.f. basis Alexandria. As usual, it is expected that there will be very keen competition for this business, although it is rarely that those who get it make much profit out of it. Apart from this, there is not much being done in the way of operating in coals ahead, and so far as can be ascertained, the leading firms of middlemen are not as yet purchasing supplies for 1928. The tendency all round appears to be to proceed only on a hand-to-mouth principle, and even in this respect it cannot be said that there is really much activity. The current demand for coals of all descriptions falls short of market requirements, so that the individual position of collieries is in most cases far from satisfactory. This is shown by the tonnage available. At the end of last week there were forty-one tipping appliances idle at the various docks, and on Monday the situation was not a great deal improved as the result of arrivals of steamers over the week-end, for there were still twenty-four tips at a standstill.

Traffic at Welsh Ports.

The figures issued by the Great Western Railway Company respecting the traffic at the ports in this district under its control show that for the four weeks ended October 30th last imports and exports totalled 2,617,651 tons, which compares with 676,667 tons for the same period of last year. Last year was, however, considerably affected by the national coal stoppage, so that it is scarcely a fair criterion. Taking, however, the figures for the forty-four weeks of this year to October 30th last, it is seen that imports and exports amount to 31,467,082 tons, which compares with 28,995,733 tons for the same period of 1925, and with 17,010,536 tons for the same period of 1926. Compared therefore with 1925 the returns for this year afford some satisfaction. The exports of coal and coke amount to 23,265,124 tons from January 1st to October 30th last, which compares with 21,757,206 tons for the same period of 1925.

Engineering Exhibition.

The sixth engineering exhibition promoted by the South Wales Institute of Engineers opened at Cardiff on Wednesday of last week, and continues until the end of this week. It is, of course, connected chiefly with the coal industry, and has been visited by colliery owners, managers and engineers and by a host of others interested in the latest engineering productions. Experts have declared that the exhibition is the last word in projects of this description. The trouble of the organisers has always been that their space has been so limited. They could easily have filled a hall double the size of that available. The demand for accommodation has been, as usual, very heavy, but the promoters have had to restrict the letting space. One effect of this, of course, is that the many firms which have stands make the utmost use of them, and display only the very latest specialities. This year the number of exhibitors is over seventy, and the exhibits are fully representative of the manufacturers of the whole of the country.

Newport Works.

As the result of the depressed condition of the sheet trade, Messrs. Lysaght's works at Newport have this week commenced to operate on the basis of a three-day week. For some little time past they have been working four days a week. The employers have, however, promised their employees, numbering about 2500, that they will give them a full week before Christmas.

Tin-plate Trade.

THE conditions in the tin-plate industry are better and it is estimated that about fifty more mills are now operating as compared with a month ago. The demand for supplies has improved. Both employers and men are co-operating to remove grievances respecting the quality of plates, and it is expected that that in time will have a very beneficial influence on trade.

Patent Fuel Works.

The Star Patent Fuel Company, in which the Powell Duffryn Steam Coal Company, Ltd., is interested, has decided permanently to close down its works at Blackweir, Cardiff, and about 150 men have been given notice. It is hoped, however, that many of the men will be absorbed for employment at the new patent fuel works which the company is erecting on a site adjoining the Roath Basin, Bute Docks, Cardiff.

Current Business.

The tone of the steam coal market remains unchanged, and is quiet in all departments. Large qualities are freely offered for early loading, and even smalls are more plentiful and slightly lower in price. The patent fuel and coke markets continue to be featureless, and although the demand for pitwood in the circumstances is very limited prices of this commodity are steadier, owing to the restricted quantities which are being imported. Foreign exports of coal for the week ended November 25th were only just over 407,000 tons, as against rather more than 435,000 tons for the preceding week.

CONTRACTS.

DAVEY, PAXMAN AND CO., Ltd., of Colchester, have received orders for heavy oil Diesel engines from the War Office for Chatham and for Jamaica; from the Thames Sand Dredging Company, Ltd.; and from the Alloa Shipbreaking Company, Ltd., for Rosyth Dockyard.

THE WESTINGHOUSE BRAKE AND SAXBY SIGNAL COMPANY, Ltd., of 82, York-road, King's Cross, London, N. 1, has received from the London, Midland and Scottish Railway an order for an installation of power signalling in connection with the remodelling of Victoria and Exchange stations at Manchester. The installation will include three new signal-boxes, one at Deal-street of ninety-nine levers, another at Victoria West of ninety-five levers, and the third at Irwell Bridge of fifteen levers. There will be 128 electrically driven point machines, which will be fed by direct current from bus-bars supplied from the alternating-current mains through Westinghouse metal rectifiers. Over 200 colour light signals of four, three, and two aspects will be employed, as well as twenty-six optical route indicators, and there will be 176 alternating-current condenser fed track circuits.

THE contract for the construction of the permanent way for the extension of the Hudson Bay Railway from Mile 356 to Fort Churchill, the recently chosen ocean terminus, has been awarded by the Canadian Government to the firm of Stewart and Cameron, Ltd., Winnipeg, Manitoba. Seven tenders were received. That of Stewart and Cameron, Ltd., was the lowest. As the tender is on a schedule-rate basis, the exact amount involved is not ascertainable, but it is estimated to be in the neighbourhood of 1,250,000 dollars. The contract calls for the clearing, grubbing, crosswaying, grading and culvert excavation of approximately 154 miles of line. The supervision, direction and general acceptance of the work will be placed under the Canadian National Railway Company, as agents for the Crown. Work is to commence immediately, and the contract calls for completion by September 1st, 1929.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

MR. JAMES CHAPMAN, M.I. Struct. E., asks us to announce that he has changed his address from 35, Pretoria-road, Streatham, S.W. 16, to 435, Mansion House Chambers, London, E.C. 4. Telephone: City 7092.

THE L.H.M. ENGINEERING COMPANY, Ltd., asks us to announce that it has changed its address from 17, Dartmouth-street, S.W. 1, to 32, Victoria-street, Westminster, S.W. 1. Telephone: Victoria 2206; telegrams: Elaitcheng, Parl., London.

BROWN BROTHERS, Ltd., Great Eastern-street, London, E.C. 2, ask us to announce that they have been appointed sole distributors amongst motor garages of Crawshaw's Chemical Colander which we described in our issue of September 16th.

ALL old members of the London Army Troops Companies Royal Engineer Volunteers are specially invited to the annual dinner of the corps, which will be held at the Engineers' Club, Coventry-street, W. 1, on Wednesday, December 14th next. Applications for tickets from members of the corps and its predecessors, the Engineering Institutions Volunteer Corps, the Architects Corps, the L.C.C. Corps, may be made to Mr. C. E. Campbell, 25, Newman-street, Oxford-street, W. 1, or to any of the company officers, or to Colonel C. B. Clay, Hurst, Sundridge-avenue, Bromley, Kent.

THE INSTITUTION OF AUTOMOBILE ENGINEERS.—Twenty-one! Twenty-one already? It seems only the other day that we were congratulating it upon its sprightly youth and now it is full grown. It does not seem to have altered it much: its dinner on Wednesday night was just as bright and happy, with just that touch of irresponsibility which one might have found any time these twenty years past. And it was the biggest, too, not only because everyone wanted to be present at the Institution's coming-of-age party, but because there was to be dancing afterwards. Major Guy Beaumont made an admirable chairman. His speech was good, clear, and to the point, and the other speeches, by Sir Henry Fowler, Mr. W. J. Tennant and Lieut.-General Sir Webb Gillman, Master-General of the Ordnance, were all short and effective. There was, too, an excellent musical programme. Altogether an excellent evening, upon which the only blot was the absence of Basil Joy, whose appendix very discourteously insisted upon being removed a couple of days ago. Everyone was rejoiced when the President announced that he was progressing admirably, and a proposal by Mr. Thomas Clarkson that a special message should be sent to him from the diners was approved with acclamation.

THE INSTITUTION OF CHEMICAL ENGINEERS.—The Board of Examiners on the Examination for Associate-Membership of the Institution of Chemical Engineers, June-July, 1927, says in its report:—"The holding of the second public examination in chemical engineering in this country in June-July of this year, not unlike the first, has revealed features which call for comment. In preparing the questions, no attempt was made to depart from the standard which was set in the examination of 1926. On the contrary, the questions were designed to test not only the knowledge of the candidates in the matter of fundamentals, but to ascertain their ability to attack some of the ordinary problems with which a chemical engineer is faced. While some of the questions concerned some special aspect of the technology of a particular industry, others invited a decision on aspects relating to the solution of typical chemical engineering problems and the application of fundamental chemical engineering knowledge and economics. The work of some of the candidates reached a much higher level than in 1926, and ability has been shown in the application of physical-chemical and engineering principles to the solution of given problems. There is still, however, a tendency to ignore the specific points in respect of which information is sought, and for the replies to be of a general or descriptive character, and unnecessarily diffuse. In future examinations it is recommended that questions bearing on the "Outline of Training" should be confined to three written papers, and that the fourth should be assigned to the preparation of a simple working drawing. The second examination has again revealed that most of the candidates are lacking in a knowledge of heat transfer."

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	18/6 to 21/-
(1) Spanish	18/6 to 21/-
(1) N. African	18/6 to 21/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	21/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 16 0	—
No. 1 Foundry	3 17 6	—
No. 3 Foundry	3 12 6	—
N.E. COAST—		
Hematite Mixed Nos.	3 11 6	3 11 6
No. 1	3 12 0	3 12 6
Cleveland—		
No. 1	3 7 6	3 7 6
Silicious Iron	3 7 6	3 7 6
No. 3 G.M.B.	3 5 0	3 5 0
No. 4 Foundry	3 4 0	3 4 0
No. 4 Forge	3 3 6	3 3 6
Mottled	3 3 0	3 3 0
White	3 3 0	3 3 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
,, ,, Foundry	3 6 0	—
(3) Northampton—		
Foundry No. 3	3 0 6 to 3 1 0	
Forge	2 14 0	—
(3) Derbyshire—		
No. 3 Foundry	3 5 6 to 3 6 0	
Forge	2 19 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 4 0 to 3 5 0	
No. 4 Forge	3 2 6	—
Basic	3 2 6	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 6 6 (a) / 4 9 6 (b) / 4 13 0 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export £ s. d.
SCOTLAND—		
Crown Bars	10 15 0	10 5 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 15 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
LANCS.—		
Crown Bars	10 0 0	—
Second Quality Bars	9 10 0	—
Hoops	12 10 0	—
S. YORKS.—		
Crown Bars	11 0 0	—
Best Bars	12 5 0	—
Hoops	12 10 0	—
MIDLANDS—		
Crown Bars	9 10 0 to 10 0 0	
Marked Bars (Staffs.)	13 0 0	—
Nut and Bolt Bars	9 0 0 to 9 5 0	
Gas Tube Strip	11 10 0	—

STEEL. (d)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ¾in. and up	8 2 6	7 12 6
Sections	7 12 6	7 2 6
Steel Sheets, ¼in.	8 15 0 to 8 17 6	8 15 0
Sheets (Gal. Cor. 24 B.G.)	14 5 0	£13 12 6

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 2 6	—
Angles	7 12 6	—
Boiler Plates	12 10 0	—
Joists	7 12 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 12 6	—
Soft Billets	7 12 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	
Billets	7 10 0 to 10 0 0	
MANCHESTER—		
Bars (Round)	8 10 0	—
,, (Small Round)	7 12 6	—
Hoops (Baling)	10 5 0	10 0 0
,, (Soft Steel)	9 0 0	8 15 0
Plates	8 7 6	—
,, (Lancs. Boiler)	10 10 0	—
SHEFFIELD—		
Siemens Acid Billets	10 0 0	—
Hard Basic	7 12 6 to 8 2 6	
Intermediate Basic	7 10 0	—
Soft Basic	6 10 0	—
Hoops	10 0 0 to 10 10 0	
Soft Wire Rods	9 5 0	—
MIDLANDS—		
Small Rolled Bars	7 12 6 to 8 0 0	
Billets and Sheet Bars	6 5 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	13 5 0 to 13 10 0	
Angles	7 12 6	—
Joists	7 12 6	—
Tees	8 12 6	—
Bridge and Tank Plates	8 7 6	—
Boiler Plates	11 0 0 to 11 10 0	

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	17/9 to 18/-
Block Tin (cash)	267 7 6
,, (three months)	265 7 6
Copper (cash)	59 1 3
,, (three months)	59 6 3
Spanish Lead (cash)	21 16 3
,, (three months)	22 0 0
Spelter (cash)	26 12 6
,, (three months)	26 6 3
MANCHESTER—	
Copper, Best Selected Ingots	65 2 6
,, Electrolytic	65 5 0
,, Strong Sheets	88 0 0
,, Tubes (Basis Price), lb.	0 1 0¾
Brass Tubes (Basis Price), lb.	0 0 11¾
,, Condenser, lb.	0 1 1¾
Lead, English	23 5 0
,, Foreign	22 0 0
Spelter	26 17 6
Aluminium (per ton)	£107

FERRO ALLOYS.

	Per Ton	Per Unit.
Tungsten Metal Powder	1/8 per lb.	
Ferro Tungsten	1/3 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	7/6
,, ,, 6 p.c. to 8 p.c. ,,	£22 17 6	7/3
,, ,, 8 p.c. to 10 p.c. ,,	£22 10 0	6/6
,, ,, Specially Refined		
,, ,, Max. 2 p.c. carbon	£36 0 0	11/6
,, ,, ,, 1 p.c. carbon	£41 10 0	15/-
,, ,, ,, 0·70 p.c. carbon	£53 0 0	17/6
,, ,, ,, carbon free	1/4 per lb.	
Metallic Chromium	3/- per lb.	
Ferro Manganese (per ton)	£12 0 0 for home; £16 for export	
,, Silicon, 45 p.c. to 50 p.c.	£12 15 0 scale 5/- per unit	
,, ,, 75 p.c.	£20 5 0 scale 6/- per unit	
,, Vanadium	14/3 per lb.	
,, Molybdenum	5/- per lb.	
,, Titanium (carbon free)	0/11½ per lb.	
Nickel (per ton)	£170	
Ferro-Cobalt	9/3 per lb.	

FUELS.

SCOTLAND.
(Prices not stable.)

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	13/3
,, ,, Ell	14/-
,, ,, Splint	15/6 to 18/-
,, ,, Trebles	14/6
,, ,, Doubles	13/6
,, ,, Singles	10/6 to 10/9
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/3
,, ,, Jewel	15/6
,, ,, Trebles	14/9
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	12/- to 12/9
Screened Navigation	18/-
Trebles	14/3 to 16/6
Doubles	13/6 to 13/9
Singles	10/9 to 11/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	12/9
Secondary Steam	12/3
Trebles	14/-
Doubles	13/9
Singles	10/9

ENGLAND.

	Inland.	Export.
(8) N.W. COAST—		
Steams		24/- to 25/-
Household		40/- to 56/-
Coke		22/6 to 23/6
NORTHUMBERLAND—		
Best Steams		13/6 to 14/-
Second Steams		12/9 to 13/-
Steam Smalls		9/- to 10/-
Unscreened		13/- to 13/6
Household		21/- to 27/-
DURHAM—		
Best Gas		15/6 to 16/-
Second		13/3 to 14/-
Household		21/- to 27/-
Foundry Coke		19/- to 26/-
SHEFFIELD—		
Best Hand-picked Branch	28/- to 30/6	—
Derbyshire Best Bright House	21/6 to 22/6	—
Best House Coal	21/- to 21/6	—
Screened House Coal	18/- to 19/-	—
,, ,, Nuts	16/- to 17/6	—
Yorkshire Hards	14/6 to 16/6	—
Derbyshire Hards	15/- to 17/-	—
Rough Slacks	8/6 to 9/6	—
Nutty Slacks	6/- to 7/-	—
Smalls	3/- to 4/6	—
Blast-furnace Coke (Inland)	12/- to 13/- at ovens	—
Furnace and Foundry Coke (Export), f.o.b.		17/- to 18/-

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	19/- to 19/6
Second Smokeless Large	18/6 to 19/-
Best Dry Large	18/3 to 18/9
Ordinary Dry Large	17/6 to 18/-
Best Black Vein Large	17/9 to 18/-
Western Valley Large	17/6 to 17/9
Best Eastern Valley Large	17/- to 17/6
Ordinary Eastern Valley Large	16/9 to 17/-
Best Steam Smalls	12/6 to 12/9
Ordinary Smalls	11/- to 12/6
Washed Nuts	18/- to 20/6
No. 3 Rhondda Large	19/6 to 20/-
,, ,, Smalls	15/- to 15/6
No. 2 ,, Large	16/- to 16/6
,, ,, Through	14/6 to 15/6
,, ,, Smalls	13/- to 13/6
Foundry Coke (export)	30/- to 37/6
Furnace Coke (export)	27/6 to 30/-
Patent Fuel	22/6 to 24/-
Pitwood (ex ship)	28/- to 28/3
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	32/6 to 35/-
Seconds	26/- to 29/6
Red Vein	20/6 to 25/-
Machine-made Cobbles	35/- to 40/-
Nuts	38/6 to 42/6
Beans	22/6 to 28/-
Peas	17/- to 19/-
Breaker Duff	8/6 to 9/-
Rubbly Culm	7/9 to 8/-
Steam Coals:	
Large	18/- to 19/-
Seconds	16/- to 17/-
Smalls	10/3 to 11/3
Cargo Through	15/- to 16/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (d) Rebate 7/6 joists and 5/- all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(From our Correspondent in Paris.)

Comptoirs and Prices.

So large are the stocks of rolled iron and steel that holders are making efforts to dispose of them at specially low prices, without, however, tempting buyers to accept their offers, and until the stocks are reduced, there can be no question of the mills and forges returning to a normal week's work. In the same way large consignments of iron and steel have been sent abroad, and that has given the impression of an improved foreign demand, but as makers are unable to continue supplying at unprofitable rates, and prices have been hardening, it is probable that the export consignments will be checked. The only exception is Germany, which is taking larger quantities of rolled steel. In view of the unremunerative character of the export trade mill and forge owners are endeavouring to put up prices on the home market by the constitution of national *comptoirs* for the sale of all kinds of rolled material, similar to the girder, tube and rod makers' associations, which are either working or are on the point of being formed. Such groups are difficult to organise, but they are usually successful in their aims at fixing uniform prices, and it is hoped that the probable creation of *comptoirs* will have the effect of inducing consumers to buy for stock at present low prices. There is, however, a general reluctance to lay in stocks, and the quantity of steel going into consumption is small. Recent quotations for fairly large quantities have been 740 f. per metric ton for mild steel bars at works in the Meurthe-et-Moselle, 680 f. to 690 f. for plates, and 780 f. to 820 f. for thick sheets, while the price of 950 f. to 1000 f. for thin sheets is more or less nominal.

Foreign Trade.

The activity of the export trade is observable in the quantities, but values continue to decline. During the first ten months of the year there were increases except in the imports of manufactured goods and the exports of produce, although the suppression of the prohibitions will certainly give more importance to the exports of produce in the future. The total quantity of imports during the ten months was 41,641,075 tons, an increase on the corresponding period of last year of 3,708,629 tons. Of this, raw material accounted for more than 35 million tons, largely in the form of coal and coke. The exports totalled 31,411,773 tons, an augmentation of 4,417,328 tons. Here again raw material amounted to 25,809,361 tons. This category includes blooms and billets and all partly manufactured material. The increase was 3,884,305 tons. Values underwent a heavy contraction all round, except in the case of produce. The imports were valued at 43,005 million francs, a decline of 6332 million francs, and the exports were estimated at 45,333 million francs, a declension of 3584 million francs. While the exports of manufactured goods increased by 638,987 tons, the values declined by 3693 million francs.

Commercial Aviation.

A meeting at Nantes of representatives of Chambers of Commerce from the western and south-western districts and an important meeting of the Société Française de Navigation Aérienne, under the chairmanship of Marshal Lyautey, have given further prominence to the propaganda for the creation of a network of air lines in this country. At Nantes the Chambers of Commerce unanimously approved of the creation of six lines, on condition of one line being put into service at the earliest possible moment in order to provide data to show whether the other lines are likely to be successful. The proposed lines are from Bordeaux to Nantes and Cherbourg, with extensions to the North of England ; Bordeaux to Morocco, West Africa and South America ; Nantes to Lyons, connecting with the lines to Geneva and Central Europe ; Paris to Brest ; Havre to Tours and Cherbourg to Toulon. The programme of the Société de Navigation Aérienne is much more ambitious and comprises five transversal lines and seven lines radiating from Paris to the frontier and coastal towns. It receives the support of some State departments, notably the Post Office, the representative of which declared that the postal freights alone would do much to help some of the national lines pay their way. The programme is strongly criticised on the ground that it is merely a copy of the German air system which shows a constant deficit, and can only be kept going by the payment of subsidies, mainly by the towns which are served by the lines, and it is extremely doubtful whether such a service can be successful in France where such financial aid cannot be depended upon, and where there would certainly be a wholly insufficient passenger traffic. The only practical scheme for the moment is the running of an experimental line with a view to the creation of the system, in a more or less modified form, proposed by the Chambers of Commerce.

Oil Monopoly.

A law creating what is virtually an oil monopoly for the State was to have come into force in April last, but owing to the difficulties encountered its operation was postponed until January next, by which time the provisions of the law were to be entirely modified. It hardly seems possible that the final arrangements will be terminated by then. Under this scheme the State will in no way be an actual participant in the financial organisation, but it will create import licences and will control the business in such a way as to favour the development of the home oil-refining interests. The refiners will also have to arrange for the stocking of oil necessary for purposes of national defence, and the State control will have the effect of regulating prices, and at the same time every source of foreign supply will be drawn upon, particularly those in which the French have a financial interest. The problem is not easy to solve, for the law that was to have been put in operation in April last had to be suspended in order to avoid reprisals from the United States. The Commission des Pétroles has not even yet begun to examine the new Bill, so that a further postponement will almost certainly be necessary at the beginning of the year.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

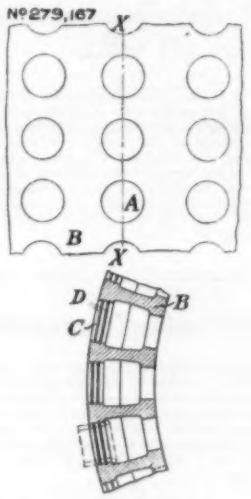
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application ; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

279,167. July 21st, 1926.—METHOD OF FITTING BOILER TUBES INTO TUBE PLATES, the Stirling Boiler Company, Ltd., of 32 and 33, Farringdon-street, London, E.C. 4, and Henry John Sutherland Mackay, of 6, Charles-street, St. James'-square, London, S.W. 1.

In modern boiler practice the tendency is towards the employment of continuously increasing pressure to such an extent that the drums of water-tube boilers have to be built with plates which may require to be several inches in thickness. Experience shows that sufficient lodgment of the tube in the drum plates may be obtained if the tubes are in intimate contact with the plates for about one quarter of the thickness of the latter. In accordance with this invention the tube holes A are formed by drilling a pilot hole and enlarging it by means of a cutter or otherwise a portion of its length, thus leaving a portion between

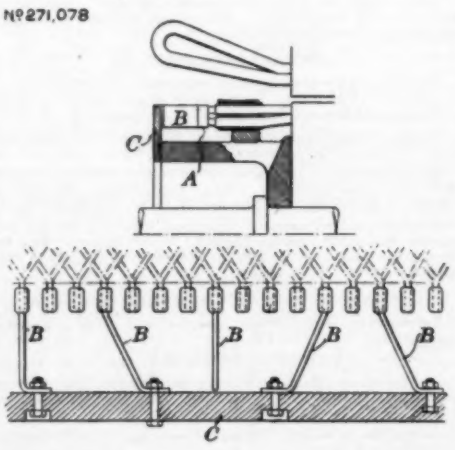


the enlargement and the outer surface of the tube plate sufficient for expansion of the tube. The portion C between the outer surface of the tube plate B and the enlargement is then drilled to suit the diameter of the tube to be inserted, and preferably and as shown spaced annular grooves D are cut in the portion of the wall of the tube hole so as to increase the adhesion on expansion of the tube. The tube is then introduced from the outer side of the tube plate and the expander inserted from the inner side of the tube plate. Owing to the provision of the enlargement the expander can be operated to expand the tube over the whole surface of the portion C which is sufficient for expanding purposes. The tube which projects a short distance into the enlargement is then preferably bell-mouthed as indicated by a suitable tool to increase the adhesion of the tube to the tube plate.—*October 21st*, 1927.

DYNAMOS AND MOTORS.

271,078. May 10th, 1927.—IMPROVEMENTS IN OR RELATING TO COOLING DYNAMO ELECTRIC MACHINES, *The British Thomson-Houston Company, Ltd., Crown House, Aldwych, London, W.C.* 2.

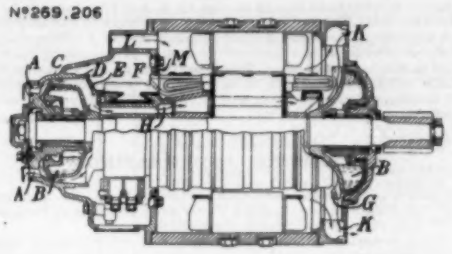
According to this invention the ends of the rotor winding are extended, and by means of caps A fan vanes B are supported



between the ends of the windings and an insulating disc C. The lower illustration shows various possible arrangements, where it will be seen that some of the vanes are straight whilst others are inclined. Alternative methods of fixing the vanes to the disc are also shown in the lower illustration.—*October 20th*, 1927.

269,206. April 9th, 1927.—IMPROVEMENTS IN OR RELATING TO DYNAMO-ELECTRIC MACHINES, *Metropolitan-Vickers Electrical Company, Ltd., of 4, Central-buildings, Westminster.*

On railway motors, and particularly those used in sandy districts, it is necessary to segregate the space surrounding the commutator so that the brushes and commutator may not be unduly worn by gritty substances carried by the ventilating air. It is practically necessary in a traction motor to draw the ventilating air from the commutator end of the machine. The bearing at the commutator end has openings A, and the incoming air is drawn over the rotating oil storing chamber B. The bearing housing C has a cylindrical member D, and there is a baffle at the part E. The space F is therefore protected from

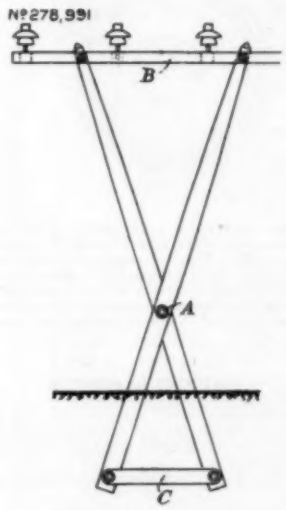


the grid-laden ventilating air, which enters through the passages A. The manner in which the air passes through the machine is indicated by the arrows. At the pinion end the rotating oil storing chamber B has radially extending fan blades G, and air is drawn through the rotor ventilating passages H, and is expelled through the outlet vents K. The stator is ventilated by the same fan blades that ventilate the motor, and the air is drawn through the ducts L, a baffle being provided at M.—*October 20th*, 1927.

TRANSMISSION OF POWER.

278,991. June 9th, 1927.—IMPROVED MAST FOR CARRYING ELECTRIC AERIAL LINES, Gunnar Kjaer, of Sortedamsdossering 45, Copenhagen, Denmark.

A mast for carrying electric overhead lines, constructed in accordance with this invention, consists of two supports which cross one another as shown, and are joined together by a bolt A.

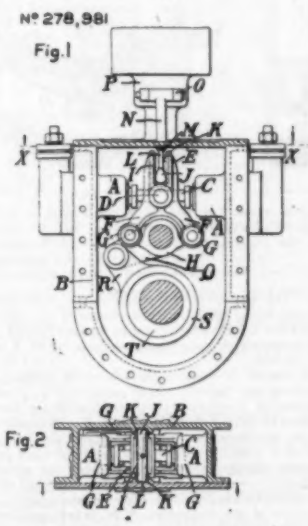


At the top of the structure there is a horizontal member B, which supports the insulators that carry the overhead lines, whilst at the lower part of the masts which are buried in the ground there is a horizontal member C, which can be provided with anchorage devices of various kinds. Masts constructed in accordance with the invention may be made of wood, iron or other material.—*October 20th*, 1927.

PUMPING AND BLOWING MACHINERY.

278,981. May 12th, 1927.—VARIABLE STROKE PUMPS, P. H. Peel, 23, Holly-road, Ipswich.

As shown in this drawing A, A are pump cylinders mounted in alignment in the walls of a casing B and having a single piston rod C serving for both cylinders. This piston-rod carries a gudgeon



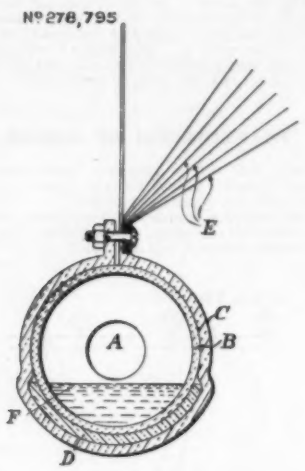
pin D on which a forked lever E is mounted to oscillate. The arms or branches F of the forked lever carry at their extremities bosses or rollers G in contact with the periphery of a cam H, which may be of suitable profile to ensure that the lever E is moved positively in both directions and has no lost motion or

backlash. The lever E also has a slot I formed in it, and a fulcrum bar J which extends through this slot, is guided in guideways K provided on the walls of the casing B. By adjusting the position of the fulcrum bar J in the guideway K, when the fixed throw cam H operates to oscillate the lever E about this fulcrum, a variable stroke is imparted to the piston-rod C through the gudgeon pin D. The position of the fulcrum can be varied whilst the lever is oscillating as well as when it is at rest. The movement of the fulcrum bar can be effected by any convenient device either by hand or automatically. In the arrangement shown the fulcrum bar is moved by a rod L connected by a knuckle joint M to a link N moved by a lever O forming part of a governor or other suitable control device P. The cam H can be conveniently oscillated by means of an arm Q fast on the cam spindle and pivotally connected to an arm R extending from an excentric strap S mounted on an excentric T, to which a continuous rotary movement is imparted in any convenient manner.—*October 20th*, 1927.

LIGHTING AND HEATING.

278,795. July 10th, 1926.—IMPROVEMENTS IN AND RELATING TO MERCURY AND OTHER VAPOUR LAMPS, David Moncrieff Lumsden, Almondbank, Perthshire.

This invention relates to mercury and other vapour lamps with two mercury or other vapourisable metal electrodes in a quartz or other suitable vessel. A is the arc tube, B the bulb, C a metal strip enclosing the bulb, D a pad of asbestos, and E

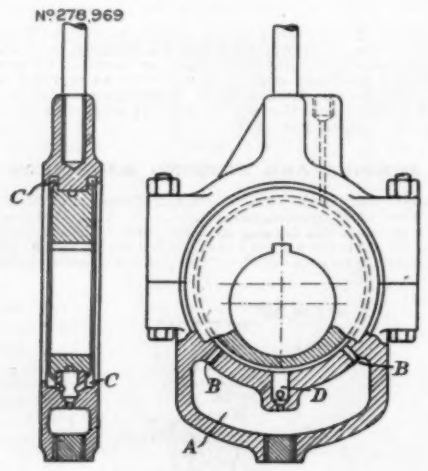


radiating vanes forming a continuation of the band C. The level of the mercury F corresponds with the upper edge of the insulating material. The pad serves to retain the heat in the mercury, while the metal strip and the vanes E serve to conduct the heat away from the vapour in the upper part of the bulb. The cooling or condensing effort within the bulbs is regulated by varying the angle of the vanes with respect to each other.—*October 10th*, 1927.

MISCELLANEOUS.

278,969. March 28th, 1927.—LUBRICATING EXCENTRICS, Ing. E. Mandler, Liesing, near Vienna, Austria, and Climax Motorenwerke und Schiffswerft Linz A.G., 18, Schwarzenbergplatz, Vienna I, Austria.

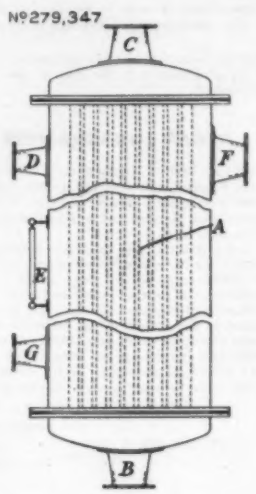
For the purpose of lubricating the rubbing surface of an



excentric, or a crank pin, the oil is contained in a reservoir A, formed as part of the excentric strap. The movement of the parts drives the oil up through the passages B B into the annular recesses C C, whence, after lubricating the rubbing faces, it escapes back to the reservoir by way of the port D.—*October 20th*, 1927.

279,347. May 30th, 1927.—IMPROVEMENTS IN THE CATALYTIC PRODUCTION OF HYDROCARBONS FROM OXIDES OF CARBON AND HYDROGEN, James Yate Johnson, of 47, Lincoln's Inn-fields, London.

The formation of gaseous, liquid and solid hydrocarbons from oxides of carbon and hydrogen, or gases splitting off hydrogen, in the presence of a catalyst is accompanied by a considerable disengagement of heat, which has the disadvantage of greatly increasing the temperature of the reacting gas mixture and of the catalyst and thereby often gives rise to secondary reactions, such as the deposition of carbon, whereby the catalyst is soon rendered inactive. Moreover, since excessive temperatures modify the state of equilibrium very unfavourably with regard to the formation of the desired product, it is impossible, in working on a commercial scale, to obtain a large output, for example of high-grade methane, by a single passage of the gases over the catalyst. It has been found that this objection can be overcome, and the heat resulting from the reaction be advantageously utilised, by connecting the reaction chamber with a generator of high-pressure steam in such a way as to effect an exchange of heat between them. Use is made of a steam boiler, in which steam is generated at a pressure of 17 atmospheres, corresponding to a temperature of 205 deg. Centigrade. In this boiler there are tubes A containing the catalyst, for example, an activated nickel catalyst. A mixture of carbon monoxide and hydrogen is introduced at B and passed over the catalyst, the resulting gas mixture leaving the apparatus at C. The heat generated by the reaction serves for the produc-



tion of steam of 17 atmospheres pressure which is led off at D In this manner the production of methane, for example, may be carried on without any interruption by reason of over-heating or through stoppage of the catalytic action as the result of excessive cooling. E indicates the gauge glass of the boiler, F the connection to the safety-valve and G the inlet for the supply of water to the boiler. The inlet G may also serve for the introduction, for example, of superheated steam or hot gases in order to obtain the necessary temperature for starting the reaction.—*October 27th*, 1927.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. "Cutting Tools Research Committee. Report on Cutting Temperatures: their Effect on Tools and on Materials Subjected to Work," by Mr. E. G. Herbert. 6 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Yorkshire District Meeting at Bradford. 4.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Informal meeting. Questions and discussions. 7.30 p.m.

KEIGHLEY ASSOCIATION OF ENGINEERS.—Queen's Hotel Keighley. Lecture, "Some Beauty Spots in Yorkshire," by Mr. A. W. Barker. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Mining Institute, Newcastle-on-Tyne. Paper, "Essential Aspects of Form and Proportions as Affecting Merchant Ship Resistance and a New Method of Estimating E.H.P.," by Mr. A. L. Ayre. 6 p.m.

SATURDAY, DECEMBER 3RD.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—College of Technology, Sackville-street, Manchester. Paper, "Foundry Practice in the United States of America," by Mr. E. Longden. 4 p.m.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—Queen's Hotel, Birmingham. Annual Dinner.

INSTITUTION OF CIVIL ENGINEERS.—Students' visit to the works for the new offices of the London Electric Railways at St. James's Park Station, S.W. 1.

MONDAY, DECEMBER 5TH.

INSTITUTION OF AUTOMOBILE ENGINEERS: WESTERN CENTRE.—Merchant Venturers' Technical College, Bristol. Paper, "Pinking and Dopes," by Professor K. C. Browning. 6.45 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. General meeting. 5 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Cantor Lecture, "Alloy Steels, their Manufacture, Properties and Uses," by Professor H. C. H. Carpenter. 8 p.m.

SOCIETY OF ENGINEERS.—Geological Society's Rooms, Burlington House, Piccadilly, London, W. 1. Paper, "The Preservation of the Purity of River Water, with Regard to Pisciculture," by Dr. W. Rushton. 6 p.m.

MONDAY TO FRIDAY, DECEMBER 5TH TO 9TH.

SMITHFIELD CLUB SHOW.—Agricultural Hall, Islington, London, N. 1.

TUESDAY, DECEMBER 6TH.

INSTITUTE OF MARINE ENGINEERS.—85-88, The Minories, Tower Hill, London, E. 1. Lecture, "The Story of the Ship," by Sir Westcott S. Abell. 6.30 p.m.

INSTITUTE OF METALS: NORTH-EAST COAST LOCAL SECTION.—Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-upon-Tyne. "Hot Extrusion Process," by Mr. J. E. Newson. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "Control in Carburation," by Mr. W. A. Whatmough. 7.45 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. "A Year's Work in X-Ray Crystal Analysis," by Sir William Bragg. 5.15 p.m.

SHEFFIELD METALLURGICAL ASSOCIATION.—198, West-street, Sheffield. "The Determination of Molten Metal Temperatures," by Mr. R. S. Whipple. 7.30 p.m.

WEDNESDAY, DECEMBER 7TH.

INSTITUTE OF METALS: SWANSEA LOCAL SECTION.—Thomas' Café, High-street, Swansea. "Extrusion," by Mr. R. Genders. 7 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: BRADFORD CENTRE.—Belle Vue Hotel, Bradford. Paper, "Design and its Effect on Maintenance Charges," by Mr. F. H. Paul. 7 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, London, S.W. 1. Informal meeting. Discussion on "The Effect of Pumping Operations on Underground Waters," introduced by Dr. H. Lapworth. 6 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, London, W.C. 2. Wireless Section meeting. Paper, "The Attenuation of Wireless Waves Over Land," by Mr. R. H. Barfield. 6 p.m.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS.—Caxton Hall, Westminster, London, S.W. 1. Paper, "The Comparative Values of Air Treatment as Applied to Ventilation," by Mr. W. H. Dupen. 7 p.m.

INSTITUTION OF SANITARY ENGINEERS.—Caxton Hall, Westminster, London, S.W. 1. Paper, "The Use of Reinforced Concrete in Waterworks and Sewerage," by Mr. G. T. Cotterell. 7 p.m.

LIVERPOOL ENGINEERING SOCIETY.—9, The Temple, Dale-street, Liverpool. Joint meeting with the North-Western Branch of the Institution of Mechanical Engineers. Paper, "Modern Portland Cement Plant," by Mr. Hal Gutteridge. 6 p.m.

NEWCOMEN SOCIETY.—Institution of Mechanical Engineers, Storey's Gate, Westminster, London, S.W. 1. Presidential address, "Making and Rolling Iron," by Mr. J. W. Hall. 5.30 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. "The Damage to Cargo Due to 'Ship's Sweat,'" by Mr. S. J. Duly. 8 p.m.

WEDNESDAY TO FRIDAY, DECEMBER 7TH TO 9TH.

INSTITUTION OF CHEMICAL ENGINEERS.—Chemical Society's Rooms, Burlington House, Piccadilly, London, W. 1. Conference. For programme, see page 608.

THURSDAY, DECEMBER 8TH.

INSTITUTE OF METALS: LONDON LOCAL SECTION.—Society of Motor Manufacturers and Traders, 83, Pall Mall, London, S.W. 1. Joint meeting with the Institute of British Foundrymen. Paper, "Strip Casting," by Mr. W. A. C. Newman. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Cavendish Café, Cornmarket, Derby. Paper, "Notes on Skewed Gears," by Mr. F. Gaze. 7.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—Visit to the Works of the Fisher Bookbinding Company (1912), Ltd., at Herne Hill. 3 p.m.

ROYAL AERONAUTICAL SOCIETY.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "Fog," by Captain F. Entwistle. 6.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. "Petroleum Natural Gases and Their Derivatives," by Mr. J. Kewley. 5.15 p.m.

FRIDAY, DECEMBER 9TH.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—Applied Science Department of the University, St. George's-square, Sheffield. "Stresses in Non-Ferrous Castings," by Professor C. H. Desch. 7.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's Gate, Westminster, London, S.W. 1. Informal meeting. "Economics in Engineering," by Major S. J. Thompson. 7 p.m.

INSTITUTION OF WATER ENGINEERS.—Geological Society's Rooms, Burlington House, Piccadilly, London, W. 1. Winter general meeting. "Rainfall and Flow-off, River Garry, Inverness-shire," by Captain W. N. McClean; "Underground Water Supplies, and the Need for Investigation of the Sources Thereof," by Mr. S. R. Rafferty; "Failure of Slow Sand Filtration in Madras City," by Mr. J. W. Madeley. 10.30 a.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. "Management Graphics," by Mr. T. G. Rose. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Bolbec Hall, Newcastle-upon-Tyne. Informal meeting. Discussion on "The Relation Between the Drawing Office and the Shipyard and Engine Works," introduced by Mr. C. Waldie Cairns. 7.15 p.m.

MONDAY, DECEMBER 12TH.

INSTITUTE OF METALS: SCOTTISH LOCAL SECTION.—Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. "Age-hardening of Alloys," by Dr. R. Ray. 7.30 p.m.

RAILWAY CLUB.—25, Tothill-street, London, S.W. 1. Paper, "The Story of a Derelict Line—the Chesterford and Newmarket Railway," by Mr. K. Brown. 7.30 p.m.

WEDNESDAY, DECEMBER 14TH.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. "The Evolution of Modern Road Surfaces," by Major R. G. H. Clements. 8 p.m.

THURSDAY, DECEMBER 15TH.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—The Engineers' Club, Waterloo-street, Birmingham. "Duralumin," by Dr. L. Aitchison. 7 p.m.

INSTITUTE OF PATENTEES.—Caxton Hall, Westminster, London, S.W. 1. "The Commercialisation of Inventions in this Country," by Mr. A. Ryner. 8 p.m.

FRIDAY, DECEMBER 16TH.

INSTITUTION OF LOCOMOTIVE ENGINEERS: MANCHESTER CENTRE.—College of Technology, Sackville-street, Manchester. Short papers by Messrs. G. C. R. Parker and R. C. Bond. 7 p.m.

POLYTECHNIC ENGINEERING SOCIETY.—309, Regent-street, London, W. 1. Annual conversazione. (Tickets obtainable from the Secretary.) 7.30 p.m.

ALLEN-LIVERSIDGE, LTD.: LONDON STAFF DINNER.—The annual dinner of the London staff of Allen-Liversidge, Ltd., was held at the Trocadero Restaurant on Friday evening last. Some two hundred members of the staff—male and female—and guests sat down under the chairmanship of Mr. Harry Stevenson, who is also chairman of the company. A departure was made from the practice of past years, in that, in addition to that of "The King," there was only one toast. After the former had been drunk with musical honours, the chairman, who was suffering from a severe cold, spoke a few words of welcome to the assembled company, and then called upon Mr. T. G. Allen to propose the health of "The Ladies." A most amusing dissertation followed, and the toast was heartily drunk. No reply was called for. The dinner, which was excellent in every way, was followed by a dance, and a most enjoyable evening was spent by everyone.